Upon receipt of the product and prior to initial operation, read these instructions thoroughly, and retain for future reference.

MOTOMAN INSTRUCTIONS

MOTOMAN-□□□ INSTRUCTIONS
DX200 INSTRUCTIONS
DX200 OPERATOR'S MANUAL (for each purpose)
DX200 MAINTENANCE MANUAL

The DX200 operator’s manual above corresponds to specific usage. Be sure to use the appropriate manual.
MANDATORY

• This manual explains the synchronized-to-conveyor control with shift functions of the DX200 system for teaching, playback, editing of jobs and files, and management of each operation. Read this manual carefully and be sure to understand its contents before handling the DX200.

• General items related to safety are listed in Chapter 1: Safety of the DX200 Instructions. To ensure correct and safe operation, carefully read the Setup Manual before reading this manual.

CAUTION

• Some drawings in this manual are shown with the protective covers or shields removed for clarity. Be sure all covers and shields are replaced before operating this product.

• The drawings and photos in this manual are representative examples and differences may exist between them and the delivered product.

• YASKAWA may modify this model without notice when necessary due to product improvements, modifications, or changes in specifications. If such modification is made, the manual number will also be revised.

• If your copy of the manual is damaged or lost, contact a YASKAWA representative to order a new copy. The representatives are listed on the back cover. Be sure to tell the representative the manual number listed on the front cover.

• YASKAWA is not responsible for incidents arising from unauthorized modification of its products. Unauthorized modification voids your product's warranty.
We suggest that you obtain and review a copy of the ANSI/RIA National Safety Standard for Industrial Robots and Robot Systems (ANSI/RIA R15.06-2012). You can obtain this document from the Robotic Industries Association (RIA) at the following address:

Robotic Industries Association

900 Victors Way

P.O. Box 3724

Ann Arbor, Michigan 48106

TEL: (734) 994-6088

FAX: (734) 994-3338

www.roboticsonline.com

Ultimately, well-trained personnel are the best safeguard against accidents and damage that can result from improper operation of the equipment. The customer is responsible for providing adequately trained personnel to operate, program, and maintain the equipment. NEVER ALLOW UNTRAINED PERSONNEL TO OPERATE, PROGRAM, OR REPAIR THE EQUIPMENT!

We recommend approved YASKAWA training courses for all personnel involved with the operation, programming, or repair of the equipment.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications.
Notes for Safe Operation

Read this manual carefully before installation, operation, maintenance, or inspection of the DX200.

In this manual, the Notes for Safe Operation are classified as “DANGER”, “WARNING”, “CAUTION”, “MANDATORY”, or “PROHIBITED”.

![DANGER] Indicates an imminent hazardous situation which, if not avoided, could result in death or serious injury to personnel.

![WARNING] Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury to personnel.

![CAUTION] Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury to personnel and damage to equipment. It may also be used to alert against unsafe practices.

![MANDATORY] Always be sure to follow explicitly the items listed under this heading.

![PROHIBITED] Must never be performed.

Even items described as “CAUTION” may result in a serious accident in some situations.

At any rate, be sure to follow these important items.

---

To ensure safe and efficient operation at all times, be sure to follow all instructions, even if not designated as “DANGER”, “WARNING” and “CAUTION”.

---
WARNING

- Before operating the manipulator, check that servo power is turned OFF pressing the emergency stop buttons on the front door of the DX200 and the programming pendant. When the servo power is turned OFF, the SERVO ON LED on the programming pendant is turned OFF.

Injury or damage to machinery may result if the emergency stop circuit cannot stop the manipulator during an emergency. The manipulator should not be used if the emergency stop buttons do not function.

Fig. : Emergency Stop Button

- Once the emergency stop button is released, clear the cell of all items which could interfere with the operation of the manipulator. Then turn the servo power ON.

Injury may result from unintentional or unexpected manipulator motion.

Fig. : Release of Emergency Stop

- Observe the following precautions when performing teaching operations within the P-point maximum envelope of the manipulator:
  - Be sure to use a lockout device to the safeguarding when going inside. Also, display the sign that the operation is being performed inside the safeguarding and make sure no one closes the safeguarding.
  - View the manipulator from the front whenever possible.
  - Always follow the predetermined operating procedure.
  - Keep in mind the emergency response measures against the manipulator’s unexpected motion toward you.
  - Ensure that you have a safe place to retreat in case of emergency.

Improper or unintended manipulator operation may result in injury.

- Confirm that no person is present in the P-point maximum envelope of the manipulator and that you are in a safe location before:
  - Turning ON the power for the DX200.
  - Moving the manipulator with the programming pendant.
  - Running the system in the check mode.
  - Performing automatic operations.

Injury may result if anyone enters the P-point maximum envelope of the manipulator during operation. Always press an emergency stop button immediately if there is a problem. The emergency stop buttons are located on the right of front door of the DX200 and the programming pendant.
Definition of Terms Used Often in This Manual

The MOTOMAN is the YASKAWA industrial robot product.

The MOTOMAN usually consists of the manipulator, the controller, the programming pendant, and supply cables.

In this manual, the equipment is designated as follows:

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Manual Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>DX200 controller</td>
<td>DX200</td>
</tr>
<tr>
<td>DX200 programming pendant</td>
<td>Programming pendant</td>
</tr>
<tr>
<td>Cable between the manipulator and the controller</td>
<td>Manipulator cable</td>
</tr>
</tbody>
</table>

CAUTION

- Perform the following inspection procedures prior to conducting manipulator teaching. If problems are found, repair them immediately, and be sure that all other necessary processing has been performed.
  - Check for problems in manipulator movement.
  - Check for damage to insulation and sheathing of external wires.
- Always return the programming pendant to the hook on the cabinet of the DX200 after use.

The programming pendant can be damaged if it is left in the manipulator's work area, on the floor, or near fixtures.

- Read and understand the Explanation of Warning Labels in the DX200 Instructions before operating the manipulator:
Conveyor Synchronized Function with Shift Functions

Description of the Operation Procedure

Descriptions of the programming pendant keys, buttons, and displays are shown as follows:

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Manual Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Programming Pendant</td>
<td>Character Keys /Symbol Keys</td>
</tr>
<tr>
<td></td>
<td>The keys which have characters or its symbol printed on them are denoted with []. ex. [ENTER]</td>
</tr>
<tr>
<td>Axis Keys /Numeric Keys</td>
<td>[Axis Key] and [Numeric Key] are generic names for the keys for axis operation and number input.</td>
</tr>
<tr>
<td>Keys pressed simultaneously</td>
<td>When two keys are to be pressed simultaneously, the keys are shown with a “+” sign between them, ex. [SHIFT]+[COORD]</td>
</tr>
<tr>
<td>Displays</td>
<td>The menu displayed in the programming pendant is denoted with {}. ex. {JOB}</td>
</tr>
</tbody>
</table>

Description of the Operation Procedure

In the explanation of the operation procedure, the expression "Select • • • " means that the cursor is moved to the object item and [SELECT] is pressed, or that the item is directly selected by touching the screen.

Registered Trademark

In this manual, names of companies, corporations, or products are trademarks, registered trademarks, or brand names for each company or corporation. The indications of (R) and ™ are omitted.
Safeguarding Tips

All operators, programmers, maintenance personnel, supervisors, and anyone working near the system must become familiar with the operation of this equipment. All personnel involved with the operation of the equipment must understand potential dangers of operation. General safeguarding tips are as follows:

- Improper operation can result in personal injury and/or damage to the equipment. Only trained personnel familiar with the operation of this equipment, the operator's manuals, the system equipment, and options and accessories should be permitted to operate this equipment.

- Improper connections can damage the equipment. All connections must be made within the standard voltage and current ratings of the equipment.

- The system must be placed in Emergency Stop (E-Stop) mode whenever it is not in use.

- In accordance with ANSI/RIA R15.06-2012, section 4.2.5, Sources of Energy, use lockout/tagout procedures during equipment maintenance. Refer also to Section 1910.147 (29CFR, Part 1910), Occupational Safety and Health Standards for General Industry (OSHA).

Mechanical Safety Devices

The safe operation of this equipment is ultimately the user's responsibility. The conditions under which the equipment will be operated safely should be reviewed by the user. The user must be aware of the various national codes, ANSI/RIA R15.06-2012 safety standards, and other local codes that may pertain to the installation and use of this equipment.

Additional safety measures for personnel and equipment may be required depending on system installation, operation, and/or location. The following safety equipment is provided as standard:

- Safety barriers
- Door interlocks
- Emergency stop palm buttons located on operator station

Check all safety equipment frequently for proper operation. Repair or replace any non-functioning safety equipment immediately.
All operators, programmers, maintenance personnel, supervisors, and anyone working near the system must become familiar with the operation of this equipment. Improper operation can result in personal injury and/or damage to the equipment. Only trained personnel familiar with the operation, manuals, electrical design, and equipment interconnections of this equipment should be permitted to program, or maintain the system. All personnel involved with the operation of the equipment must understand potential dangers of operation.

- Inspect the equipment to be sure no potentially hazardous conditions exist. Be sure the area is clean and free of water, oil, debris, etc.
- Be sure that all safeguards are in place. Check all safety equipment for proper operation. Repair or replace any non-functioning safety equipment immediately.
- Check the E-Stop button on the operator station for proper operation before programming. The equipment must be placed in Emergency Stop (E-Stop) mode whenever it is not in use.
- Back up all programs and jobs onto suitable media before program changes are made. To avoid loss of information, programs, or jobs, a backup must always be made before any service procedures are done and before any changes are made to options, accessories, or equipment.
- Any modifications to the controller unit can cause severe personal injury or death, as well as damage to the robot! Do not make any modifications to the controller unit. Making any changes without the written permission from YASKAWA will void the warranty.
- Some operations require a standard passwords and some require special passwords.
- The equipment allows modifications of the software for maximum performance. Care must be taken when making these modifications. All modifications made to the software will change the way the equipment operates and can cause severe personal injury or death, as well as damage parts of the system. Double check all modifications under every mode of operation to ensure that the changes have not created hazards or dangerous situations.
- This equipment has multiple sources of electrical supply. Electrical interconnections are made between the controller and other equipment. Disconnect and lockout/tagout all electrical circuits before making any modifications or connections.
- Do not perform any maintenance procedures before reading and understanding the proper procedures in the appropriate manual.
- Use proper replacement parts.
- Improper connections can damage the equipment. All connections must be made within the standard voltage and current ratings of the equipment.
Maintenance Safety

Turn the power OFF and disconnect and lockout/tagout all electrical circuits before making any modifications or connections.

Perform only the maintenance described in this manual. Maintenance other than specified in this manual should be performed only by YASKAWA-trained, qualified personnel.

Summary of Warning Information

This manual is provided to help users establish safe conditions for operating the equipment. Specific considerations and precautions are also described in the manual, but appear in the form of Dangers, Warnings, Cautions, and Notes.

It is important that users operate the equipment in accordance with this instruction manual and any additional information which may be provided by YASKAWA. Address any questions regarding the safe and proper operation of the equipment to YASKAWA Customer Support.
If you need assistance with any aspect of your Conveyor Synchronized Function with Shift Functions system, please contact YASKAWA Customer Support at the following 24-hour telephone number:

(937) 847-3200

For routine technical inquiries, you can also contact YASKAWA Customer Support at the following e-mail address:

technical_support@motoman.com

When using e-mail to contact YASKAWA Customer Support, please provide a detailed description of your issue, along with complete contact information. Please allow approximately 24 to 36 hours for a response to your inquiry.

Please use e-mail for routine inquiries only. If you have an urgent or emergency need for service, replacement parts, or information, you must contact YASKAWA Customer Support at the telephone number shown above.

Please have the following information ready before you call Customer Support:

- System: Conveyor Synchronized Function with Shift Functions
- Primary Application ___________________________
- Controller: DX200
- Software Version: Access this information on the Programming Pendant’s LCD display screen by selecting {MAIN MENU} - {SYSTEM INFO} - {VERSION}
- Robot Serial Number: Located on the robot data plate
- Robot Sales Order Number: Located on the DX200 controller data plate
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1 Conveyor Synchronized Function with Shift Functions

1.1 Conveyor Synchronized Function with Shift Functions

In the conveyor synchronized function of the position tracking type, the taught motion path of the manipulator is corrected according to the conveyor travel amount so that the manipulator performs follow-up motion in the conveyor moving direction at a constant relative speed to the workpiece.

There are two conveyor synchronized function types:
Manipulator follow-up control: The manipulator’s basic axis moves in synchronization with the conveyor movement.
Travel-axis follow-up control: A travel axis (external axis) moves in synchronization with the conveyor movement.

When the conveyor synchronized function is used with “shift functions,” it is useful for a situation where the conveyor home-position limit switch, the workpiece identification detecting limit switch (WORK ID detecting limit switch), and the workpiece detecting limit switch (WORK IN/NOT detecting limit switch) cannot be installed near the manipulator. Using the conveyor synchronized function with shift functions, the information of all the workpieces that pass all the limit switches to reach the synchronization start position of the manipulator can be managed.

And then, when a workpiece reaches the manipulator start position, the corresponding job is started so that the manipulator can start the job in synchronization with the conveyor.

In such operation flow, the section from each limit switch to the manipulator start position is defined as “shift section,” and the section from the manipulator start position to the synchronization start position of the manipulator is defined as “synchronized section.”
1.2 Start Shift Function

When the conveyor home-position limit switch is not installed near the manipulator, the second workpiece may pass the conveyor home-position limit switch before the first workpiece, which passed the conveyor home-position limit switch, enters the conveyor synchronized section.

The DX200 manages the position information of all the workpieces that passed the conveyor home-position limit switch, and starts the job programmed for each workpiece when the corresponding workpiece reaches the manipulator start position so that the manipulator executes the job in the follow-up motion to the conveyor.

For the above control, the start shift function manages up to 99 workpiece position data from the conveyor home-position limit switch to the reference workpiece for synchronization start.
1.3 WORK ID Shift Function

When the workpieces are conveyed sequentially and the WORK ID detecting limit switch is turned ON, the DX200 reads the WORK ID of each workpiece by the predefined general-purpose input signal. When the WORK ID detecting limit switch is not installed near the manipulator, the second workpiece may pass the WORK ID detecting limit switch before the first workpiece, which passed the WORK ID detecting limit switch, enters the conveyor synchronized section.

The DX200 manages the WORK ID information of all the workpieces that passed the WORK ID detecting limit switch, and starts the job programmed for each workpiece when the corresponding workpiece reaches the manipulator start position so that the manipulator executes the job in the follow-up motion to the conveyor.

For the above control, the WORK ID shift function manages the WORK ID information up to 99 workpieces in the section from the WORK ID detecting limit switch to the reference workpiece for synchronization start.

- Setting image of the shipment before DN1.60-00

- Setting image of the new shipment at DN1.60-00 or later
1.4 WORK IN/NOT Shift Function

In the system that workpieces are conveyed in skits, the WORK IN/NOT detecting limit switch is activated when a skit passes, and the DX200 reads whether a workpiece is in or not from the predefined general-purpose input signal.

When the WORK IN/NOT detecting limit switch is not installed near the manipulator, the second workpiece may pass the WORK IN/NOT detecting limit switch before the first workpiece, which passed the WORK ID detecting limit switch, enters the conveyor synchronized section. The DX200 manages the WORK IN/NOT information obtained through the WORK IN/NOT detecting limit switch. When the DX200 receives the information that a workpiece is in the skit, the DX200 starts the job for the workpiece to move the manipulator in synchronization with the conveyor.

For the above control, the WORK IN/NOT shift function manages up to 99 skit data in the section from the WORK IN/NOT detecting limit switch to the reference workpiece for synchronization start.

- Setting image of the shipment before DN1.60-00

- Setting image of the new shipment at DN1.60-00 or later
1.5 Precautions on Using Conveyor Synchronized Function with Shift Functions

With the conveyor synchronized function with shift functions, the shift data such as Start Shift, WORK ID, and WORK IN/NOT in the synchronized section and shift section are all erased when the power is OFF. Take this into account when activating the function after the power is ON.

When all the shift functions such as Start Shift function, WORK ID Shift function, and WORK IN/NOT Shift function are disabled (set to “NOT USED”), the DX200 operates in the same way as the operation with the basic conveyor synchronized function without shift functions. However, the job preparing method is different from the conveyor synchronized function without shift functions. Refer to section 3.8.1 “Job Example for the Conveyor Synchronized Function without Shift Functions” to prepare a job. Refer to “DX200 OPTIONS INSTRUCTIONS FOR CONVEYOR SYNCHRONIZED FUNCTION” for the basic conveyor synchronized function.
2 Conveyor Condition File

2.1 Conveyor Condition File

To execute the conveyor synchronized function with shift functions properly, the conveyor data must be set to the DX200. The data are set in the conveyor condition file, start shift condition file, WORK ID condition file, and WORK IN/NOT condition file.

The conveyor condition file sets the characteristics of the conveyor and the input method of the encoder, etc. Also, the conveyor supplemental condition file such as the Start Shift condition file, the WORK ID Shift condition file, and the WORK IN/NOT Shift condition file sets shift functions.

Although, in the above connection example, the conveyor encoder and conveyor home-position limit switch are connected to CH1, the WORK ID detecting limit switch to CH2, and the WORK IN/NOT detecting limit switch to CH3, each limit switch can be connected to any connector from CH1 to CH3 on the conveyor synchronization board JANCD-YCP02. Also, more than two different limit switches can be connected to one connector. Which limit switch is to be connected to which connector can be specified in the conveyor supplemental condition file explained later.

Refer to section 2.6 "Start Shift Condition File", section 2.8 "WORK ID SHIFT Condition File", and section 2.10 "WORK IN/NOT SHIFT Condition File" for details.

Refer to chapter 2 "Hardware Specifications" of the “DX200 OPTIONS INSTRUCTIONS FOR CONVEYOR SYNCHRONIZED FUNCTION” for the connecting method of encoder and each limit switch.
Conveyor Synchronized Function with Shift Functions

2 Conveyor Condition File

2.1 Conveyor Condition File

(1) FILE NO.
The conveyor condition file number is shown below.

(2) USED STATUS (USED/NOT USED)
Specify whether to use or not to use the conveyor condition file.

(3) PORT NO. (CN1/CN2/CN3)
Select the port number where the encoder in use is connected.
Use this port number for the start shift home-position limit switch of the conveyor synchronized function with shift functions.

(4) BROKEN LINE DETECT (ON/OFF)
Specify whether the disconnection detection is to be enabled or not.

(5) ENCODER INPUT (ENCODER/VIRTUAL ENCODER)
Specify whether the actual encoder input or a virtual pulse encoder is used for the conveyor synchronized control.
If the virtual pulse encoder is selected, the manipulator can execute the synchronized motion to the conveyor even if the encoder is not connected or the conveyor is not running, which can be used for confirming the manipulator motion at the test run.

(6) ENCODER SIGN (FORWARD/REVERSE)
Specify whether the sign of the position pulse input from the encoder should be inverted or not. When “REVERSE” is selected, the sign of the conveyor position and the data on the conveyor speed display is inverted so that the manipulator executes the follow-up motion in the reverse direction.
2 Conveyor Synchronized Function with Shift Functions

2.1 Conveyor Condition File

(7) CORRECTION (FORWARD/REVERSE)
Specify if the direction of the follow-up motion should be reversed or not. If “REVERSE” is selected, the sign of the correction position on the conveyor speed display is reversed and the manipulator executes the follow-up motion in the reversed direction.

(8) TRACKING (ROBOT AXIS/BASE AXIS)
Specify whether the manipulator is synchronized with the robot axis or the base axis (travel axis). If “BASE AXIS” is selected for the system without base axis, no synchronized motion can be performed.

(9) USER COORD NO. (1 to 63)
When “ROBOT AXIS” is selected in (8), specify the user coordinate number in whose X-axis direction the manipulator moves in synchronization with the conveyor movement.

(10) BASE AXIS (X/Y/Z)
When “BASE AXIS” is selected in (8), specify X-, Y-, or Z-axis to move in synchronization with the conveyor movement.

(11) POS RESOLUTION (0 to 999.99 μm/pulse)
This data convert one pulse from the encoder to the conveyor travel amount (μm).
For the details of setting method, refer to “4.3 Setting of Conveyor Positional Resolution” of “DX200 OPTIONS INSTRUCTIONS FOR CONVEYOR SYNCHRONIZED FUNCTION.”

(12) VIRTUAL CV SPEED (-3276.8 to +3276.7 mm/s)
When “VIRTUAL ENCODER” is selected in (5), set the virtual encoder speed.
(13) AVERAGED TRAVEL TIME (0 to 3000 ms)
Set a time to average the travel amount so that the manipulator moves smoothly at the sudden change of the conveyor speed.
When using the conveyor with large pulsation, set the value between 300 and 500. If this setting is not used, set to "0."

(14) RESET SIG. MONITOR (0 to 65535 ms)
If no encoder reset signal for a specified conveyor has been input when the SYSTART instruction is carried out, set the amount of time to wait for the conveyor home-position input signal.
If the actual waiting time is greater than the setting, the SYSTART instruction is aborted and the next instruction is carried out. Prepare the job so that the manipulator takes retreat motion by internal status.
When "0" is set, the system waits for the conveyor home-position input signal without being interrupted by the time limit for encoder reset signal monitoring.

(15) CV SPEED DOWN MODE
(EXECUTE/ALARM/PAUSE JOB/JOB INTERRUPTION AFTER OPERATION)
Specify the action of the manipulator when the conveyor speed is lowered below the conveyor speed lower limit set in (16).
• EXECUTE
Regardless of the conveyor speed, the manipulator executes the job.
When the conveyor stops, the manipulator continues the synchronized motion with the conveyor moving at the speed "0."
• ALARM
When the conveyor average speed becomes below the set value in (16) for 0.1 second or more, an alarm occurs and the manipulator stops.
• PAUSE JOB
When the conveyor average speed becomes below the set value in (16) for 0.1 second or more, the job execution is interrupted (only the move instructions are suppressed) and the manipulator performs only the follow-up motion. When the conveyor speed recovers to the set value in (16) or higher, the job execution is re-started.

(16) CV LOWER LIMIT SPEED (0 to 65535 mm/s)
When a mode other than "EXECUTE" is selected in (15), set the conveyor speed lower limit by which the manipulator takes the respective action.
Conveyor Synchronized Function with Shift Functions

<table>
<thead>
<tr>
<th>2</th>
<th>Conveyor Condition File</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>Conveyor Condition File</td>
</tr>
</tbody>
</table>

### (17) VIRTUAL ENCODER IN (0 to 4096)
Set the general-purpose input signal number to be set for the virtual encoder. When this signal is input, the encoder input enters the virtual encoder mode.

- **000**: Virtual encoder not used
- **001 to 4096**: The general-purpose input signal of the set number activates the virtual encoder mode.

### (18) VIRTUAL ENCODER OUT (0 to 4096)
When "VIRTUAL ENCODER" is selected in (5), set the general-purpose output signal number to be set for the virtual encoder output.

- **000**: Virtual encoder not used
- **001 to 4096**: The general-purpose output signal of the set number is output from the virtual encoder.

### (19) TRACKING CORRECTION (-500 to 1000 msec)
Set the tracking correction time.

*Displayed on version DN1.60-000 and later.*
2.2 Editing Conveyor Condition File

2.2.1 Display the Conveyor Condition File

Select (ROBOT) under the main menu → Select (CV CONDITION) → Display a desired conveyor condition file

1. Press the [PAGE] to display the next file number.
2. Press [SHIFT] + the [PAGE] to display the previous file number.

2.2.2 Edit the Conveyor Condition File

- Selecting “USED STATUS”
  Select “USED STATUS” → “USED” or “NOT USED” is selected alternately

- Selecting “PORT NO.”
  Select “PORT NO.” → The selection dialog appears → Select a desired port number

- Selecting “BROKEN LINE DETECT”
  Select “BROKEN LINE DETECT” → “OFF” or “ON” is selected alternately

- Selecting “ENCODER INPUT”
  Select “ENCODER INPUT” → “ENCODER” or “VIRTUAL ENCDR” is selected alternately

- Selecting “ENCODER SIGN”
  Select “ENCODER SIGN” → “FORWARD” or “REVERSE” is selected alternately

- Selecting “CORRECTION”
  Select “CORRECTION” → “FORWARD” or “REVERSE” is selected alternately

- Selecting “TRACKING”
  Select “TRACKING” → “ROBOT AXIS” or “BASE AXIS” is selected alternately

- Specifying “USER COORD NO.”
  Select “USER COORD NO.” → Enter a value by pressing [Numeric keys]
2 Conveyor Condition File

2.2 Editing Conveyor Condition File

- **Selecting “BASE AXIS”**
  - Select “BASE AXIS” → The selection dialog box appears → Select a desired axis

- **Specifying “RESOLUTION”**
  - Select “RESOLUTION” → Enter a value by pressing [Numeric keys]

- **Specifying “VIRTUAL CONVEYOR SPEED”**
  - Select “VIRTUAL CONVEYOR SPEED” → Enter a value by pressing [Numeric keys]

- **Specifying “AVERAGED TRAVEL TIME”**
  - Select “AVERAGED TRAVEL TIME” → Enter a value by pressing [Numeric keys]

- **Specifying “RESET SIGNAL MONITORING TIME”**
  - Select “RESET SIGNAL MONITORING TIME” → Enter a value by pressing [Numeric keys]

- **Selecting “CONVEYOR SPEED DOWN MODE”**
  - Select “CONVEYOR SPEED DOWN MODE” → Selection dialog box appears → Select a desired mode

- **Specifying “CONVEYOR LOWER LIMIT SPD”**
  - Select “CONVEYOR LOWER LIMIT SPD” → Enter a value by pressing [Numeric keys]

- **Specifying “VIRTUAL ENCODER INPUT”**
  - Select “VIRTUAL ENCODER INPUT” → Enter a value by pressing [Numeric keys]

- **Specifying “VIRTUAL ENCODER OUTPUT”**
  - Select “VIRTUAL ENCODER OUTPUT” → Enter a value by pressing [Numeric keys]

- **Specifying “TRACKING CORRECTION”**
  - Select “TRACKING CORRECTION” → Enter a value by pressing [Numeric keys]

---

**NOTE**

Editing the conveyor condition file clears both the shift data and the synchronization data.

Observe the above precaution when the conveyor condition file is modified.
2.3 Setting Conveyor Resolution

The encoder mounted on the conveyor sends the pulse amount to the DX200 as the conveyor current position data. In order that the manipulator recognizes this pulse amount as the conveyor travel amount for its follow-up motion, this pulse amount must be converted into a distance.

The conveyor travel amount (μm) per 1 pulse to be used for this conversion is called “RESOLUTION”. The resolution is set in units of micrometer. For example, when the conveyor resolution is 30 μm/pulse, set “RESOLUTION” to “30.00.”

The setting range is from 0 to 999.99 μm/pulse. Since the DX200 internally quadruples every encoder pulse number, the conveyor’s maximum positional resolution is 3999.96 μm/pulse.

As the resolution error is stored as much as the conveyor travel pulse amount, the setting must be correct. For example, when the resolution is set 0.01 μm/pulse bigger, the follow-up error of 0.1 mm at the point that the conveyor moves for 1000 pulses.

The conveyor resolution is mentioned in the specification of each conveyor. However, this value cannot be used because of the following reason.

As the feedback pulse becomes four times the amount of the pulse from the conveyor encoder, the conveyor resolution of the conveyor condition file is 1/4 of the conveyor resolution mentioned in your conveyor specifications.

For more detailed information on the setting method, refer to section 4.3 “Setting Conveyor Positional Resolution” of the “DX200 OPTIONS INSTRUCTIONS FOR CONVEYOR SYNCHRONIZED FUNCTION.”
2.4 Detection Function for BROKEN LINE DETECT Status (Conveyor Pulse)

When "BROKEN LINE DETECT" in the CONVEYOR COND FILE display is set ON (enabled), an alarm occurs if the broken line detection status signal for conveyor pulse is detected. The following specific outputs are used to output the disconnection detection.

For the production line, whether the alarm occurrence stops the entire line or not can be specified by the concurrent I/O ladder program or by the setting on the host controller, referring to the information of these outputs.

<table>
<thead>
<tr>
<th>51437</th>
<th>51436</th>
<th>51435</th>
<th>51434</th>
<th>51433</th>
<th>51432</th>
<th>51431</th>
<th>51430</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>BROKEN LINE DETECT (CONVEYOR COND FILE 3)</td>
<td></td>
<td>BROKEN LINE DETECT (CONVEYOR COND FILE 2)</td>
<td></td>
<td>BROKEN LINE DETECT (CONVEYOR COND FILE 1)</td>
<td></td>
</tr>
</tbody>
</table>

The time to output the broken line detection status signal can be set. Set the time to output the signal sent from the board for synchronization to the main CPU in the sensor parameter SE017 (setting for output time of broken line detection signal). This prevents the main CPU from failing to get the information of the disconnection status when the output time is too short. Set 50 ms or more considering the time lag between the signal writing of the board for synchronization and the signal reading of the main CPU.
2.5 Conveyor Supplemental Condition File

To use the conveyor synchronized function with shift functions, the conveyor supplemental condition file “CV TRACKING COND SUPP.” must be set in addition to the conveyor condition file. The CV TRACKING COND SUPP. file consists of three files: START SHIFT SET, WORK ID, SHIFT SET, and WORK IN/NOT SHIFT SET. Set the files of the functions required for your system configuration.

Conveyor supplemental condition file

- START SHIFT condition file
- WORK ID SHIFT condition file
- WORK IN/NOT SHIFT condition file
2.6 Start Shift Condition File

(1) FILE NO.
Displays the start shift condition file number.

(2) USED STATUS (USED/NOT USED)
Specify whether the start shift condition file is used or not.

(3) PORT NO.
Displays the port number where the encoder specified in the conveyor condition file is connected.

(4) CHATTERING PRVNT DIS (0 to 9999.9 mm)
While the conveyor moves for the chattering prevention distance from the moment that the conveyor home-position signal is input, the next conveyor home-position signal input is ignored.
Set "0" to disable monitoring for the chattering prevention distance and to count the number of workpieces with every input.

While the conveyor moves for this distance from the moment that the conveyor home-position signal is input, the next conveyor home-position signal is ignored.
Conveyor Synchronized Function with Shift Functions

2 Conveyor Condition File
2.6 Start Shift Condition File

(5) CHATTERING PRVNT TIME (0 to 999.9 seconds)
Until the chattering prevention time pass from the moment that the conveyor home-position input signal is input, the next conveyor home-position signal input is ignored. Set “0” to disable monitoring for the chattering prevention time and to count the number of workpieces with every input.

If both the distance and the time for the chattering prevention are set, the larger one is applied.

(6) MAX. WORK CNT (0 to 99 workpieces)
Set the maximum number of workpieces that move between the conveyor home-position limit switch to the reference workpiece for synchronization start.
(7) START SHIFT DISTANCE (0 to 99999mm)
When the conveyor home-position limit switch cannot be installed within the manipulator working envelope, the home-position limit switch ON signal is shifted in synchronization with the conveyor movement to the manipulator working envelope. Set the distance from the conveyor home-position limit switch to the shift end position. When 0 is set, the SYSTART instruction is executed when the conveyor home-position limit switch ON signal is input.

![Diagram]

Manipulator start position  Conveyor moving direction  Conveyor home-position limit switch

START SHIFT DISTANCE
2.7 Editing the Start Shift Condition File

2.7.1 Display of the Start Shift Condition File

Select (ROBOT) under the main menu → Select (CONVEYOR COND SUPP.) →
Select (DISPLAY) → Select “START SHIFT”1)

1 Press the [PAGE] to display the next file number.
Press [SHIFT] + [PAGE] to display the previous file number.

2.7.2 Editing the Start Shift Condition File

- **Selecting “USED STATUS”**
  Select “USED STATUS” → “USED” or “NOT USED” is selected alternately

- **Specifying “CHATTERING PREVENTION DISTANCE”**
  Select “CHATTERING PREVENTION DISTANCE” → Enter a value by pressing [Numeric keys]

- **Specifying “CHATTERING PREVENTION TIME”**
  Select “CHATTERING PREVENTION TIME” → Enter a value by pressing [Numeric keys]

- **Specifying “MAX. WORK FIND COUNT”**
  Select “MAX. WORK FIND COUNT” → Enter a value by pressing [Numeric keys]

- **Specifying “START SHIFT DISTANCE”**
  Select “START SHIFT DISTANCE” → Enter a value by pressing [Numeric keys]

---

**NOTE**

Editing the start shift condition file clears both the shift data and the synchronization data.

Observe the above precaution when the start shift condition file is modified.
2.8 WORK ID SHIFT Condition File

(1) FILE NO.
Displays the WORK ID SHIFT condition file.

(2) USED STATUS (USED/NOT USED)
Specify whether the WORK ID SHIFT condition file is used or not.

(3) PORT NO. (CN1/CN2/CN3)
Displays the port number where the WORK ID detecting limit switch is connected.

(4) CHATTERING PRVNT DIS (0 to 9999.9 mm)
Set a distance to prevent the repeated inputs of the WORK ID detecting limit switch signal due to the limit switch chattering. While the conveyor moves for the set distance from the moment the WORK ID detecting limit switch signal is input, another WORK ID detecting limit switch signal is ignored.
Set “0” to disable monitoring for the chattering prevention distance and to count the number of workpieces with every input.

(5) CHATTERING PRVNT TIME (0 to 999.9 sec)
Set a time to prevent the repeated inputs of the WORK ID detecting limit switch signal due to the limit switch chattering. Until the set time passes from the moment the WORK ID detecting limit switch signal is input, another WORK ID detecting limit switch signal is ignored.
Set “0” to disable monitoring for the chattering prevention time and to count the number of workpieces with every input. If both the distance and the time for the chattering prevention are set, the larger one is applied.
(6) WORK SHIFT POS (0 to 99999 mm)
Set the distance from the WORK ID detecting limit switch to the shift end position.

- For the shipment before DN1.60-00, set the value of the distance from the WORK ID detecting limit switch to the manipulator start position subtracted by 1/2 of the minimum workpiece pitch.

- For the new shipment at DN1.60-00 or later, set the value of the distance from the WORK ID detecting limit switch to the manipulator start position.
(7) **MAX. WORK CNT (1 to 99 workpieces)**
Set the maximum number of workpieces that are set between the WORK ID detecting limit switch to the reference workpiece for synchronization start.

(8) **WORK ID SIG (0 to 4096)**
Set the head general-purpose input number that specifies the WORK ID number.

(9) **WORK ID STATUS BIT (1 to 10)**
Set the number of valid bits of the WORK ID number. Maximum 10 bits can be set to specify up to the WORK ID number 1024.
2.9 Editing the WORK ID SHIFT Condition File

2.9.1 Display the WORK ID SHIFT Condition File

Select (ROBOT) under the main menu → Select (CONVEYOR COND SUPP.) → Select (DISPLAY) → Select "WORK ID SHIFT".

1. Press the [PAGE] to display the next file number.
   Press [SHIFT] + [PAGE] to display the previous file number.

2.9.2 Edit the WORK ID SHIFT Condition File

- **Selecting “USED STATUS”**
  Select "USED STATUS" → "USED" or "NOT USED" is selected alternately

- **Selecting “PORT NO.”**
  Select "PORT NO." → The selection dialog appears → Select a desired port number

- **Specifying “CHATTERING PREVENTION DISTANCE”**
  Select "CHATTERING PREVENTION DISTANCE" → Enter a value by pressing [Numeric keys]

- **Specifying “CHATTERING PREVENTION TIME”**
  Select "CHATTERING PREVENTION TIME" → Enter a value by pressing [Numeric keys]

- **Specifying “WORK SHIFT POSITION”**
  Select "WORK SHIFT POSITION" → Enter a value by pressing [Numeric keys]

- **Specifying “MAX. WORK FIND COUNT”**
  Select "MAX. WORK FIND COUNT" → Enter a value by pressing [Numeric keys]

- **Specifying “WORK ID SIGNAL”**
  Select "WORK ID SIGNAL" → Enter a value by pressing [Numeric keys]

- **Specifying “WORK ID STATUS BIT”**
  Select "WORK ID STATUS BIT" → Enter a value by pressing [Numeric keys]

**NOTE**

Editing the WORK ID SHIFT condition file clears both the shift data and the synchronization data. Observe the above precaution when modifying the WORK ID SHIFT condition file.
2.10 WORK IN/NOT SHIFT Condition File

(1) FILE NO.
Displays the WORK IN/NOT SHIFT condition file number.

(2) USED STATUS (NOT USED/USED)
Specify whether the WORK IN/NOT SHIFT condition file is used or not.

(3) PORT NO. (CN1/CN2/CN3)
Displays the port number where the WORK IN/NOT detecting limit switch is connected.

(4) CHATTERING PRVNT DIS (0 to 9999.9 mm)
Set a distance to prevent the repeated inputs of the WORK IN/NOT detecting limit switch signal due to the limit switch chattering. Until the conveyor moves for the set distance from the moment the WORK IN/NOT detecting limit switch signal is input, another WORK IN/NOT detecting limit switch signal is ignored.
Set “0” to disable monitoring for the chattering prevention distance and to count the number of workpieces with every input.

(5) CHATTERING PRVNT TIME (0 to 999.9 seconds)
Set a time to prevent the repeated inputs of the WORK IN/NOT detecting limit switch signal due to the limit switch chattering. Until the set time passes from the moment the WORK IN/NOT detecting limit switch signal is input, another WORK IN/NOT detecting limit switch signal is ignored.
Set “0” to disable monitoring for the chattering prevention time and to count the number of workpieces with every input. If both the distance and the time for the chattering prevention are set, the larger one is applied.
(6) WORK SHIFT POSITION (0 to 99999mm)

Set the distance from the WORK IN/NOT detecting limit switch to the shift end position.

- For the shipment before DN1.60-00, set the value of the distance from the WORK IN/NOT detecting limit switch to the manipulator start position subtracted by 1/2 of the minimum workpiece pitch.

- For the new shipment at DN1.60-00 or later, set the value of the distance from the WORK IN/NOT detecting limit switch to the manipulator start position.
(7) **MAX. WORK CNT (1 to 99)**
Set the maximum number of workpieces that are set between the WORK IN/NOT detecting limit switch to the reference workpiece for synchronization start.

(8) **WORK IN/NOT SIG (0 to 4096)**
Set the general-purpose output signal number that specifies the presence/absence of workpiece.
2.11 Editing the WORK IN/NOT SHIFT Condition File

2.11.1 Display the WORK IN/NOT SHIFT Condition File

Select (ROBOT) under the main menu → Select (CONVEYOR COND SUPP.) → Select (DISPLAY) → Select “WORK IN/NOT SHIFT”

1  Press the [PAGE] to display the next file number.
   Press [SHIFT] + [PAGE] to display the previous file number.

2.11.2 Edit the WORK IN/NOT SHIFT Condition File

- Selecting “USED STATUS”
  Select “USED STATUS” → “USED” or “NOT USED” is selected alternately

- Selecting “PORT NO.”
  Select “PORT NO.” → The selection dialog appears Select a desired port number

- Specifying “CHATTERING PREVENTION DISTANCE”
  Select “CHATTERING PREVENTION DISTANCE” → Enter a value by pressing [Numeric keys]

- Specifying “CHATTERING PREVENTION TIME”
  Select “CHATTERING PREVENTION TIME” → Enter a value by pressing [Numeric keys]

- Specifying “WORK SHIFT POSITION”
  Select “WORK SHIFT POSITION” → Enter a value by pressing [Numeric keys]

- Specifying “MAX. WORK FIND COUNT”
  Select “MAX. WORK FIND COUNT” → Enter a value by pressing [Numeric keys]

- Specifying “WORK IN/NOT SIGNAL”
  Select “WORK IN/NOT SIGNAL” → Enter a number by pressing [Numeric keys]

Editing the WORK IN/NOT SHIFT condition file clears both the shift data and the synchronization data.

Observe the above precaution when modifying the WORK IN/NOT SHIFT condition file.
3 Teaching

3.1 Registering Instructions

The instructions can be registered when the cursor is in the address area on the job content display in teach mode.

Select {JOB} under the main menu → Select {JOB CONTENT} → Move the cursor to the address area

3.1.1 SYSTART Instruction

- **Function**
  
The SYSTART instruction starts the conveyor synchronized control. The manipulator starts follow-up motion by a move instruction after the SYSTART instruction, or TIMER or WAIT instruction.

  When this instruction is executed, the manipulator stops and waits until the conveyor current position value exceeds the synchronization start position value. When the conveyor current position value exceeds the synchronization start position value, the manipulator starts the follow-up motion.

  When the conveyor current position value exceeds the synchronization start position value within the tolerance (OL) at the moment the SYSTART instruction is executed, the manipulator starts the follow-up motion from the point the SYSTART instruction is executed.

  When the conveyor current position value exceeds the synchronization start position value beyond the tolerance (OL) at the moment the SYSTART instruction is executed, the system variable $B008 is reset to “0,” and the manipulator executes the proceeding instruction without the synchronized motion. At the normal completion, “1” is set to the system variable $B008.

  The system variable $B008 cannot be read directly. Copy the system variable to Bxxx by using a GETS instruction and read the value.

  **<Example>**
  
  GETS B000 $B008
  JUMP *NG IF B000<1
### 3 Teaching

#### 3.1 Registering Instructions

When the SYSTART instruction has been executed and then another SYSTART instruction is executed in the middle of the job, the manipulator completes the execution of the previous move instruction, and tracks the conveyor in the stand-by posture until the conveyor reaches the synchronization start position for the next SYSTART instruction. Then, when the conveyor reaches the synchronization start position, the manipulator executes the next instruction.

When the SYEND instruction with a tag CONT (continuity attribute) is executed in the middle of the job of a SYSTART instruction and then another SYSTART instruction is executed, the manipulator completes the execution of the previous move instruction and stops without changing its posture until the conveyor reaches the synchronization start position for the next SYSTART instruction. When the conveyor reaches the synchronization start position, the manipulator starts the follow-up motion to the conveyor.

#### Format

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>SYSTART</td>
<td>CV#(1)</td>
<td>STP=50.000</td>
<td>OL=10.</td>
</tr>
</tbody>
</table>

1. **Conveyor condition file No. (CONVEYOR FILE)**
   Set the conveyor condition data file No. to be used.

2. **Synchronization start position (SYNC START POS)**
   Set the conveyor position where the synchronized operation starts.

3. **Tolerance (OVER LIMIT)**
   The maximum excess to execute the synchronized operation when the conveyor current position value exceeds the synchronization start position value at the execution of SYSTART instruction. When omitted or 0 is set, tolerance check is not executed.

#### Registering the SYSTART Instruction

Move the cursor to the line just above the place where a SYSTART instruction is to be registered Press [INFORM LIST] → Select “SYSTART” → Change the additional items → Press [INSERT] and [ENTER]

1. The instruction list dialog appears.

2. The SYSTART instruction is displayed in the input buffer line.
3.1 Registering Instructions

Conveyor Synchronized Function with Shift Functions

3. <Register without editing the additional items>
   Perform the operation 4.

<Edit the additional items>
- To change the conveyor condition file number or/and the synchronization start position
  Move the cursor to CONVEYOR FILE or SYNC START POS, and press [SELECT].
  Enter a desired number or value by using [Numeric keys], then press [ENTER].
- To add, change, or delete an additional item
  Move the cursor to the instruction in the input buffer line, and press [SELECT].
  The detail edit display appears.

![Detail Edit Display]

To add a tolerance, select “UNUSED” in OVER LIMIT. And then the selection dialog appears. Select “OL=.”

![Selection Dialog]

After having added or changed the additional items, press [ENTER]. The detail edit display is closed and the job content display appears.

4. The instruction displayed in the input buffer line is registered.
3.1 Registering Instructions

3.1.2 SYEND Instruction

**Function**

The SYEND instruction ends the conveyor synchronized control. The synchronized operation ends at the step where this instruction is registered.

Executing a SYEND clears the conveyor home-position data. When the conveyor home-position limit switch is ON after the conveyor home-position data is cleared, the conveyor home position data will be updated.

Execution of this instruction after CVQUE instruction invalids the position table of the workpiece in case there is no following position data of the workpiece.

Without this instruction, the SYSTART instruction is terminated before the workpiece passes the manipulator and the cursor may move to the next instruction.

Register the SYEND instruction to the following places:

- End step of the synchronization
- Head of the synchronizing operation line
- After the CVQUE instruction

For the details, refer to section 3.8 “Job Examples” on page 3-13.

**Format**

<table>
<thead>
<tr>
<th>SYEND</th>
<th>CV#(1)</th>
<th>CONT</th>
</tr>
</thead>
</table>

1. **Conveyor condition file No. (CONVEYOR FILE)**

Set the conveyor condition file number to be used.

2. **Continuity attribute**

Without ON signal from the conveyor home-position limit switch, the DX200 executes the SYSTART instruction and the manipulator starts the follow-up motion when the conveyor current position reaches and passes the synchronization start position. (Refer to section 3.1.1 “SYSTART Instruction”) The manipulator stops while it waits for the start of the follow-up motion.

**Registering the SYEND Instruction**

Move the cursor to the line just above the place where a SYEND instruction is to be registered Press [INFORM LIST] → Select “SYEND” → Change the additional items → Press [INSERT] and [ENTER]

1. The instruction list dialog appears.

2. The SYEND instruction is displayed in the input buffer line.

3. The instruction displayed in the input buffer line is registered.
The conveyor synchronized motion can be suspended in the middle of a job. To suspend the conveyor synchronized motion, insert the SYEND instruction added with a tag CONT (continuity attribute). The manipulator completes the execution of the previous move instruction of the SYEND instruction with a tag CONT, and stops to wait until the conveyor current position value reaches the value set for STP of the next SYSTART instruction. To wait until the conveyor current position value reaches the value set in STP for the SYSTART instruction moving the manipulator with the follow-up control to the conveyor, keep the SYSTART instruction executed without using the SYEND instruction.

### 3.1.3 SYMOV □ Instruction

#### Function
These move instructions executes the conveyor synchronized motion. Except that the conveyor positions at the time of teaching are registered as CTP (conveyor position at teaching), these instructions are same as ordinary move instructions. Joint motion, linear interpolation, and circular interpolation can be performed in the same way as the ordinary move instructions.

| SYMOVJ | Conveyor synchronized joint motion |
| SYMOVL | Conveyor synchronized linear interpolation |
| SYMOVC | Conveyor synchronized circular interpolation |

When these instructions are used, the teaching method is different from that with the ordinary move instructions. Refer to section 3.1.5 “Interpolation Mode for Conveyor Synchronized Motion”

#### Format
- SYMOVJ \( V=50.00 \) \( CV\#(1) \) \( CTP=100.000 \)
- SYMOVL \( V=200.00 \) \( CV\#(1) \) \( CTP=100.000 \)
- SYMOVC \( V=200.00 \) \( CV\#(1) \) \( CTP=100.000 \)

1. **Play speed**
   - Set the manipulator motion speed in playback mode.
2. **Conveyor condition file number**
   - Set the conveyor condition file number to be used.
3. **Conveyor position at teaching**
   - Set the conveyor position at teaching.
### Precautions on Executing the SYMOVJ Instruction

The SYMOVJ instruction calculates the orbit based on the conveyor speed when beginning to operate. The robot operation changes according to the conveyor speed changes to maintain a relative position of robot and conveyor (work) positions. The robot operation stops, too, when the conveyor stops. When the conveyor speed goes up again, the robot operation is restarted.

During the synchronized operation with the conveyor, three axes of the manipulator wrist may move faster than the set play-speed regardless of the conveyor moving direction. Therefore, set approximately 70% maximum of the actual play-speed for the SYMOVJ instruction. However, even if the play speed for the SYMOVJ instruction is set lower than 70%, the wrist may not be able to move depending on the conveyor speed or the manipulator’s wrist posture. In such a case, reset the play speed lower.

### 3.1.4 CVQUE Instruction

**Function**

The CVQUE instruction switches the conveyor position data, which is used for the conveyor synchronized motion, to the position data of the next workpiece. If the next workpiece information is not set in the shift table, the CVQUE instruction is ignored.

If the CVQUE instruction is executed after the end of conveyor synchronized motion for the workpiece 1, the conveyor position data switches to the position data for the workpiece 2.

Register the SYEND instruction after this instruction,

Execution of the SYEND instruction after this instruction invalids the position table of the workpiece in case there is no following position data of the workpiece.

Without this instruction, the SYSTART instruction is terminated before the workpiece passes the manipulator and the cursor may move to the next instruction.
3.1 Registering Instructions

**Conveyor Synchronized Function with Shift Functions**

- **Format**
  
  CVQUE CV#(1)

  ![ Conveyor condition file number ]

  Set the conveyor condition file number to be used.

  For the shipment before DN1.60-00, when the CVQUE instruction is executed, the first information of the WORK ID shift data and WORK IN/NOT shift data are set to the system variables and deleted from each shift data.

  For the new shipment at DN1.60-00 or later, even if the CVQUE instruction is executed, the first information of the WORK ID shift data and WORK IN/NOT shift data are not set to the system variables, but they are deleted from each shift data.

  Pay attention to the execution timing of CVQUE instruction when preparing a job.

3.1.5 Interpolation Mode for Conveyor Synchronized Motion

The interpolation mode for conveyor synchronized move instruction at teaching differs from that for the standard move instruction. Switch the interpolation mode in the manner described below.

Once the conveyor positions at teaching are registered, they must be properly set up in relation to the conveyor home-position (the position where the conveyor home-position limit switch turns ON.)

- **Switching the Interpolation Mode**

  Press [SHIFT] + [MOTION TYPE]. The interpolation mode displayed in the input buffer line switches between the standard interpolation and the interpolation for synchronized motion.

  ![ Interpolation mode switching diagram ]

  Then, each time [MOTION TYPE] is pressed, the interpolation mode changes as SYMOVJ → SYMOVL → SYMOVC.
3.2 Manipulator Motion Speed

Generally, teaching in the direction opposite to the conveyor moving direction gives such a result as a manipulator can move more easily and slowly in playback operation.

In conveyor synchronized operation, the manipulator motion speed is the teaching speed added to the conveyor speed.

Refer to section 5.2 “Motion Speed” of the “DX200 OPTIONS INSTRUCTION FOR CONVEYOR SYNCHRONIZED FUNCTION” for more information on the relation between the manipulator motion speed and the conveyor moving direction.

3.3 Wrist Posture in Conveyor Synchronized Section

In the conveyor synchronized section, the manipulator wrist maintains its taught posture while the manipulator moves in synchronization with the conveyor movement. Teach a posture so that the wrist can be moved in the conveyor moving direction.

For further information on the wrist posture, refer to section 5.3 Wrist Posture in Synchronization” of "DX200 OPTIONS INSTRUCTION FOR CONVEYOR SYNCHRONIZED FUNCTION."

3.4 Changing Circular Steps

Continuous circular steps should be taught on the same conveyor position.

When continuous circular steps are taught on different conveyor positions, a motion path is different from the taught path in the synchronized motion.
3.5 Teaching

The conveyor positions at teaching are registered in a job. The conveyor position is defined as follows:

- When the start shift function is not used, the distance from the conveyor home-position (the position where the conveyor home-position limit switch turns ON) to the synchronization start position.
- When the start shift function is used, the distance from the manipulator start position to the synchronization start position.

When performing a teaching to a workpiece, move the conveyor to turn ON the conveyor home-position limit switch by the workpiece, then move to a teaching position. The position where the conveyor home-position limit switch is turned ON is automatically registered as the conveyor home-position.

\[ \text{SYMOVL } V=1000.0 \text{ CV#(1) CTP}=100.000 \]
Perform teaching after having confirmed that the conveyor is completely stopped. Teaching while the conveyor moves may cause an error or segment over alarm.

Select (ROBOT) under the main menu Select (CV MONITOR) → Move the conveyor → Press [SHIFT] + [MOTION TYPE] → Select a interpolation type → Press [Axis key] → Press [ENTER]

1. The conveyor position display appears.

```
<table>
<thead>
<tr>
<th>CONVEYOR POSITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>CURR POS(PULSES)</td>
</tr>
<tr>
<td>CVH01 004</td>
</tr>
<tr>
<td>CVH02 0</td>
</tr>
<tr>
<td>CVH03 0</td>
</tr>
</tbody>
</table>
```

In the start shift section, the workpiece position cannot be confirmed in the conveyor monitor, but can be confirmed in the conveyor monitor (shift). To display the conveyor monitor (shift), select (ROBOT) under the main menu, and select (CONVEYOR MONITOR (SHIFT)).

```
<table>
<thead>
<tr>
<th>START SHIFT SET</th>
</tr>
</thead>
<tbody>
<tr>
<td>CH1(PULSE)</td>
</tr>
<tr>
<td>No. WORK POS(PUL)</td>
</tr>
<tr>
<td>1 1840 18.4</td>
</tr>
<tr>
<td>2 420 49.2</td>
</tr>
<tr>
<td>3 6972 66.7</td>
</tr>
<tr>
<td>4 9120 81.2</td>
</tr>
<tr>
<td>5 x x x x</td>
</tr>
</tbody>
</table>

While the conveyor is moving, if there is a workpiece in the start shift section, the workpiece position measured from the manipulator start position is displayed in the column No. 1.

2. Move the conveyor. Then, stop the workpiece at the teaching position after the conveyor home-position limit switch is turned ON. At the moment the conveyor home-position limit switch is turned ON, make sure that “0” is displayed in “CURR POS (PULSE)” on the conveyor position display and the counter is reset.

```
<table>
<thead>
<tr>
<th>CONVEYOR POSITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>CURR POS(PULSES)</td>
</tr>
<tr>
<td>CVH01 0</td>
</tr>
<tr>
<td>CVH02 0</td>
</tr>
<tr>
<td>CVH03 0</td>
</tr>
</tbody>
</table>
```

When using the start shift function: Start the conveyor. Make sure that the workpiece passes the manipulator start position when the conveyor moves for the preset start shift distance or more after the conveyor home-position limit switch is turned ON.

3. The conveyor interpolation mode enters.

4. Select the interpolation method to be used by pressing [MOTION TYPE].
5. Move the manipulator to the desired position by using [Axis keys].
6. The step is registered.

When teaching the position 1000 mm from the conveyor home-position (or the manipulator start position) in linear interpolation using No.1 conveyor characteristic file, the following step is registered.
3.6  Teaching After Interruption of Synchronized Motion in Playback Operation

After the synchronized motion is interrupted by a hold operation or switching to teach mode during playback operation, another conveyor home-position cannot be registered since no conveyor home-position input signal is accepted. At this moment, the tracking status in the conveyor tracking display is “ON” (marked with "●").

In this case, another conveyor home-position can be registered by either of the following operations.

1. Add a step or change the step after interruption of synchronized motion
2. Perform another teaching (for other workpiece)

For the details of the above operations, refer to section 5.6 “Teaching After Interruption of Playback in Synchronized Operation” of “DX200 OPTIONS INSTRUCTION FOR CONVEYOR SYNCHRONIZED FUNCTION.”
3.7 Notes on Operation

The conveyor synchronized move instructions are special instructions to register the conveyor positions together with the manipulator positions. Therefore, the conveyor synchronized move instructions are different from standard move instructions such as MOVJ, and these instructions have the following restrictions on operations.

3.7.1 Confirming Reach to Step

When the manipulator reaches the target step in FWD/BWD operation or test run (step motion mode), the operation is stopped and the cursor stops blinking. In this way, it can be easily confirmed that the manipulator reaches the target step.

3.7.2 Changing Tool

The first FWD operation of the SYMOV after changing a tool should be performed on the conveyor position at changing a tool. Performing the FWD operation after changing a tool and moving the conveyor causes a segment over alarm.

3.7.3 Deleting Taught Positions

Before deleting a move instruction, the manipulator must be placed at the step position to be deleted. However, this condition cannot be satisfied with conveyor synchronized motion move instructions. This is because a taught position for a conveyor synchronized motion move instruction is interpreted to different step positions on the conveyor position, as explained before. Therefore, ordinary deleting operation is not possible. To delete a conveyor synchronized move instruction, press [MODIFY] to change the step position. Then, after the cursor blinks, press [DELETE].

3.7.4 Manipulator Stand-by Position for the SYSTART Instruction

The manipulator’s stand-by position for the SYSTART instruction should be same as the manipulator’s position for a move instruction for the conveyor synchronized motion (SYMOV) after the SYSTART instruction. If these two positions are different, the manipulator may not be on the taught position to start moving because the DX200 executes the move instruction for the conveyor synchronized motion immediately after the synchronization starts.
3.8 Job Examples

3.8.1 Job Example for the Conveyor Synchronized Function without Shift Functions

An example of the job without using the start shift is given below. Use this example as the basic programming for application to various systems.

<table>
<thead>
<tr>
<th>Instruction</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000</td>
<td>NOP</td>
</tr>
<tr>
<td>0001</td>
<td>SYEND CV#(1)</td>
</tr>
<tr>
<td>0002</td>
<td>MOVJ VJ=50.00</td>
</tr>
<tr>
<td>0003</td>
<td>SYSTART CV#(1) STP=100.000</td>
</tr>
<tr>
<td>0004</td>
<td>0004 GETS B000 $B008</td>
</tr>
<tr>
<td>0005</td>
<td>JUMP *END IF B000=0</td>
</tr>
<tr>
<td>0006</td>
<td>SYMOVL CV#(1) CTP=50.000</td>
</tr>
<tr>
<td>0007</td>
<td></td>
</tr>
<tr>
<td>0008</td>
<td>SYMOVL CV#(1) CTP=50.000</td>
</tr>
<tr>
<td>0009</td>
<td>*END</td>
</tr>
<tr>
<td>0010</td>
<td>SYEND CV#(1)</td>
</tr>
<tr>
<td>0011</td>
<td>CVQUE CV#(1)</td>
</tr>
<tr>
<td>0012</td>
<td>SYEND CV#(1)</td>
</tr>
<tr>
<td>0013</td>
<td>MOVJ V=50.00</td>
</tr>
<tr>
<td>0014</td>
<td>END</td>
</tr>
</tbody>
</table>

Set “NOT USED” for START SHIFT, WORK ID. SHIFT, and WORK IN/NOT SHIFT of the CONVEYOR COND SUPP. file.

- Do not insert the instructions “MOVJ,” “MOVL,” “MOV,” “MOV,” or “IMOV” during the conveyor synchronization (from the SYSTART instruction to the SYEND instruction). The manipulator may not be able to move depending on the manipulator’s posture in synchronization with the conveyor immediately before the execution of these instructions (move instruction status for the conveyor synchronization).

- After the SYEND instruction, insert the CVQUE instruction before the next SYSTART instruction whether the Start Shift function is used or not.
3.8.2 Job Example when Using the Start Shift Function

An example of the job using the start shift function is given below.

### Master Job

<table>
<thead>
<tr>
<th>Instruction</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000</td>
<td>NOP</td>
</tr>
<tr>
<td>0001</td>
<td>SYEND CV#(1) Resets the registered status of the conveyor's home position. The conveyor home-position limit switch becomes valid.</td>
</tr>
<tr>
<td>0002</td>
<td>*TOP</td>
</tr>
<tr>
<td>0003</td>
<td>MOVJ VJ=50.00 Moves the manipulator to the stand-by position.</td>
</tr>
<tr>
<td>0004</td>
<td>SYSTART CV#(1) STP=100.000 Conveyor synchronization start instruction When the conveyor reaches the specified position, the conveyor synchronized control starts.</td>
</tr>
<tr>
<td>0005</td>
<td>GETS B000 $B008 The system variable to indicate whether the synchronization has started normally or not The contents of $B008 is copied to B000: Synchronization started normally if B000=1, and an error occurred if B000=0</td>
</tr>
<tr>
<td>0006</td>
<td>JUMP *END IF B000=0 If B000=0 (the synchronization did not start normally), jumps to the label [*END].</td>
</tr>
<tr>
<td>0007</td>
<td>CALL JET#(1) ENTRY=18 Starts the work job registered in the job registration table 1.</td>
</tr>
<tr>
<td>0008</td>
<td>*END        Jumps here if the conveyor synchronization did not start normally.</td>
</tr>
<tr>
<td>0009</td>
<td>SYEND CV#(1) Ends the synchronization.</td>
</tr>
<tr>
<td>0010</td>
<td>CVQUE CV#(1) Switches the reference workpiece for synchronization.</td>
</tr>
<tr>
<td>0011</td>
<td>SYEND CV#(1) The position table of the workpiece becomes invalid in case there is no following position data of the workpiece.</td>
</tr>
<tr>
<td>0012</td>
<td>JUMP *TOP</td>
</tr>
<tr>
<td>0013</td>
<td>END</td>
</tr>
</tbody>
</table>

Set “USED” for START SHIFT, and set “NOT USED” for WORK ID. SHIFT and WORK IN/NOT SHIFT of the CONVEYOR COND file.

**NOTE**

- After the SYEND instruction, insert the CVQUE instruction before the next SYSTART instruction whether the Start Shift function is used or not.
- Be sure to program the SYEND instruction at the beginning of the master job to reset the registered status of the conveyor's home position.
### Work Job

<table>
<thead>
<tr>
<th>Instruction</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000 NOP</td>
<td></td>
</tr>
<tr>
<td>0001 SYSTART CV#(1) STP=200.00</td>
<td>Waits for the synchronization start of the module 1. The manipulator moves following up the conveyor until the conveyor reaches the specified position.</td>
</tr>
<tr>
<td>0002 SYMOVL CV#(1) CTP=200.00</td>
<td>Move instruction for the conveyor synchronized motion</td>
</tr>
<tr>
<td>0003 SYMOVL CV#(1) CTP=200.00</td>
<td>Move instruction for the conveyor synchronized motion</td>
</tr>
<tr>
<td>0004 SYEND CV#(1) CONT</td>
<td>Ends synchronization of module 1. Holds the conveyor synchronization.</td>
</tr>
<tr>
<td>0005 SYSTART CV#(1) STP=1000.00</td>
<td>Waits for the synchronization start of module 2. The manipulator stops and waits until the conveyor reaches the specified position.</td>
</tr>
<tr>
<td>0006 SYMOVL CV#(1) CTP=1000.00</td>
<td>Move instruction for the conveyor synchronized motion</td>
</tr>
<tr>
<td>0007 SYMOVL CV#(1) CTP=100.000</td>
<td>Move instruction for the conveyor synchronized motion</td>
</tr>
<tr>
<td>0008 SYSTART CV#(1) STP=2000.00</td>
<td>Waits for the synchronization start of module 2. The manipulator stops and waits until the conveyor reaches the specified position.</td>
</tr>
<tr>
<td>0009 SYMOVL CV#(1) CTP=2000.00</td>
<td>Move instruction for the conveyor synchronized motion</td>
</tr>
<tr>
<td>0010 SYMOVL CV#(1) CTP=2000.00</td>
<td>Move instruction for the conveyor synchronized motion</td>
</tr>
<tr>
<td>0011 END</td>
<td></td>
</tr>
</tbody>
</table>

- Do not insert the instructions "MOVJ," “MOVL," “MOVC," “MOV$," or “IMOV" during the conveyor synchronization (from the SYSTART instruction to the SYEND instruction). The manipulator may not be able to move depending on the manipulator’s posture in synchronization with the conveyor immediately before the execution of these instructions (move instruction status for the conveyor synchronization).

- Teach the target position of the manipulator for the move instruction, which is executed after the conveyor synchronized motion starts, as close as possible to the manipulator’s stand-by position before the conveyor synchronization starts. If these two positions are too far, the manipulator may not be able to move.
3.8 Job Examples

3.8.3 Job Example Using the Start Shift, WORK ID Shift, and WORK IN/NOT Shift Functions (Shipment Before DN1.60-00)

An example of the job using all the shift functions (Start Shift, WORK ID Shift, and WORK IN/NOT Shift) is given as follows.

**Master Job**

<table>
<thead>
<tr>
<th>Instruction</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000 NOP</td>
<td></td>
</tr>
<tr>
<td>0001 SYEND CV#(1)</td>
<td>Resets the registered status of the conveyor’s home position. The conveyor home-position limit switch become valid.</td>
</tr>
<tr>
<td>0002 *TOP</td>
<td></td>
</tr>
<tr>
<td>0003 MOVJ VJ=50.00</td>
<td>Moves the manipulator to the stand-by position.</td>
</tr>
<tr>
<td>0004 GETS I000 $I000</td>
<td>Gets the WORK IN/NOT shift completion status, and stores to I000.</td>
</tr>
<tr>
<td>0005 GETS I006 $I006</td>
<td>Gets the WORK ID shift completion status, and stores to I006.</td>
</tr>
<tr>
<td>0006 JUMP *TOP IF I000=0</td>
<td>If the WORK IN/NOT shift is not completed, jumps to [*TOP].</td>
</tr>
<tr>
<td>0007 JUMP *TOP IF I006=0</td>
<td>If the WORK ID shift is not completed, jumps to [*TOP].</td>
</tr>
<tr>
<td>0008 CVQUE CV#(1)</td>
<td>Switches the reference workpiece for synchronization.</td>
</tr>
<tr>
<td>0009 SYEND CV#(1)</td>
<td>The position table of the workpiece becomes invalid in case there is no following position data of the workpiece.</td>
</tr>
<tr>
<td>0010 GETS I012 $I012</td>
<td>Gets the WORK IN/NOT information, and stores to I012.</td>
</tr>
<tr>
<td>0011 GETS I018 $I018</td>
<td>Gets the WORK ID information, and stores to I018.</td>
</tr>
<tr>
<td>0012 JUMP *TOP IF I012=0</td>
<td>If no workpiece exists, the manipulator does not execute the job.</td>
</tr>
<tr>
<td>0013 SYSTART CV#(1) STP=100.00 OL=100.0</td>
<td>Start instruction for the conveyor synchronization. Starts the conveyor synchronized control when the conveyor reaches the specified position.</td>
</tr>
<tr>
<td>0014 GETS B000 $B008</td>
<td>The system variable to indicate whether the synchronization has started normally or not The contents of $B008 is copied to B000: Synchronization started normally if B000=1, and an error occurred if B000=0</td>
</tr>
<tr>
<td>0015 JUMP *END IF B000=0</td>
<td>If B000=0 (the synchronization did not start normally), jumps to the label [*END].</td>
</tr>
<tr>
<td>0016 CALL JET#(1) ENTRY=I018</td>
<td>Reads the WORK ID information stored in I018, and starts the I018 registered job in the job registration table.</td>
</tr>
<tr>
<td>0017 *END</td>
<td></td>
</tr>
<tr>
<td>0018 SYEND CV#(1)</td>
<td>Ends the synchronization.</td>
</tr>
<tr>
<td>0019 JUMP *TOP</td>
<td></td>
</tr>
<tr>
<td>0020 END</td>
<td></td>
</tr>
</tbody>
</table>

Set “USED” for the START SHIFT, WORK ID. SHIFT, and WORK IN/NOT SHIFT of the CONVEYOR COND SUPP. file.
The system variables are defined as follows:

$\text{I000}$ to $\text{I005}$: Stores the WORK IN/NOT shift completion status.

$\text{I000}$: Corresponds to the WORK IN/NOT characteristic file 1.

$\text{I005}$: Corresponds to the WORK IN/NOT characteristic file 6.

$\text{I006}$ to $\text{I011}$: Stores the WORK ID shift completion status.

$\text{I006}$: Corresponds to the WORK ID characteristic file 1.

$\text{I011}$: Corresponds to the WORK ID characteristic file 6.

$\text{I012}$ to $\text{I017}$: Stores the first WORK IN/NOT information

$\text{I012}$: Corresponds to the WORK IN/NOT characteristic file 1.

$\text{I017}$: Corresponds to the WORK IN/NOT characteristic file 6.

$\text{I018}$ to $\text{I023}$: Stores the first WORK ID information

$\text{I018}$: Corresponds to the conveyor WORK ID characteristic file 1.

$\text{I023}$: Corresponds to the conveyor WORK ID characteristic file 6.
When the first workpiece for the WORK IN/NOT shift completes the shift section, (1) is set to the system variable $I000. When the first workpiece for the WORK ID shift completes the shift section, (1) is set to the system variable $I006.

In the job, these system variables are read out, and the CVQUE instruction is executed when both the WORK IN/NOT shift and the WORK ID shift completes the respective shift sections. Executing the CVQUE instruction sets the head information of WORK IN/NOT shift data and WORK ID shift data to the system variables $I012 and $I018 respectively and switches the reference workpiece for synchronization start to the next reference workpiece.

**NOTE**

- When the conveyor synchronized function with shift function is valid, insert the CVQUE instruction and the SYEND instruction between the SYEND instruction and the next SYSTART instruction, whether the Start Shift function is used or not.
- Be sure to program the SYEND instruction at the beginning of the master job to reset the registered status of the conveyor’s home position.
3.8.4 Job Example Using the Start Shift, WORK ID Shift, and WORK IN/NOT Shift Functions (New Shipment at DN1.60-00 or Later)

An example of the job using all the shift functions (Start Shift, WORK ID Shift, and WORK IN/NOT Shift) is given as follows.

### Master Job

<table>
<thead>
<tr>
<th>Instruction</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000 NOP</td>
<td></td>
</tr>
<tr>
<td>0001 SYEND CV#(1)</td>
<td>Resets the registered status of the conveyor’s home position. The conveyor home-position limit switch become valid.</td>
</tr>
<tr>
<td>0002 *TOP</td>
<td></td>
</tr>
<tr>
<td>0003 MOV J VJ=50.00</td>
<td>Moves the manipulator to the stand-by position.</td>
</tr>
<tr>
<td>0004 GETCVSFT CV#(1) QUENO=1 WKKIND I000 WKEXIST I001 RESULT B010</td>
<td>Gets the synchronizable queue information.</td>
</tr>
<tr>
<td>0005 JUMP *TOP IF B010&lt;&gt;0</td>
<td>If information cannot be obtained with GETCVSFT, jumps to [*TOP].</td>
</tr>
<tr>
<td>0006 JUMP *END IF I001=0</td>
<td>If the WORK IN/NOT information is NOT, jumps to [*END].</td>
</tr>
<tr>
<td>0007 SYSTART CV#(1) STP=100.00 OL=100.0</td>
<td>Start instruction for the conveyor synchronization. Starts the conveyor synchronized control when the conveyor reaches the specified position.</td>
</tr>
<tr>
<td>0008 GETS B000 $B008</td>
<td>The system variable to indicate whether the synchronization has started normally or not. The contents of $B008 is copied to B000: Synchronization started normally if B000=1, and an error occurred if B000=0</td>
</tr>
<tr>
<td>0009 JUMP *SYEND IF B000=0</td>
<td>If B000=0 (the synchronization did not start normally), jumps to the label [*SYEND].</td>
</tr>
<tr>
<td>0010 CALL JET#(1) ENTRY=I000</td>
<td>Reads the WORK ID information stored in I000, and starts the I000 registered job in the job registration table.</td>
</tr>
<tr>
<td>0011 *SYEND</td>
<td>Ends the synchronization.</td>
</tr>
<tr>
<td>0012 SYEND CV#(1)</td>
<td></td>
</tr>
<tr>
<td>0013 *END</td>
<td></td>
</tr>
<tr>
<td>0014 CVQUE CV#(1)</td>
<td>Switches the reference workpiece for synchronization.</td>
</tr>
<tr>
<td>0015 JUMP *TOP</td>
<td></td>
</tr>
<tr>
<td>0016 END</td>
<td></td>
</tr>
</tbody>
</table>

Set “USED” for the START SHIFT, WORK ID, SHIFT, and WORK IN/NOT SHIFT of the CONVEYOR COND SUPP. file.

---

**NOTE**

Be sure to program the SYEND instruction at the beginning of the master job to reset the registered status of the conveyor’s home position.
3.9 Manual Setting Function for Conveyor Position

With the manual setting function for conveyor position, the conveyor position can be set from the programming pendant without moving the conveyor to modify the taught job. Using this function, instead of moving the conveyor to move the workpiece to the teaching position, by removing a fastening device such as a dog and moving the workpiece to the desired position on the conveyor, the conveyor position can be input to modify the taught job. When the taught job is modified by using the manual setting function for conveyor position, the newly-set value of the conveyor position is registered to the value of CTP when the registration of the move instruction for the synchronized motion (SYMOV) is modified.

Select {ROBOT} under the main menu → Select {MANUAL CONVEYOR} 1)

1 The MANUAL CONVEYOR display appears.

① CV#
Displays the conveyor characteristic file number CV#1 to 3.

② CURRENT(mm)
Displays the conveyor’s current position (in actual amount of pulses). When the manual setting function for the conveyor position is used, the position data set is displayed.

③ SET POSITION (mm)
Sets the conveyor position. A value out of the setting range cannot be entered.

④ SET
Enables or Disables the manual setting mode for the conveyor position.
3.9 Manual Setting Function for Conveyor Position

3.9.1 Manual Setting Procedure for the Conveyor Position

- **Setting the Conveyor Position**
  
  Move the cursor to the desired value in the column of the \( \text{(SET (mm))} \) → Enter a value using [Numeric keys]

- **Validating or Invalidating the Manual Setting**
  
  Move the cursor to the desired value in the column of the \( \text{(SET)} \) → Press [SELECT] *1

*1 "VALID" or "INVALID" alternately appears.

3.9.2 Precautions

- **When the Power is Turned ON**
  
  When the power is turned ON, all the manual setting functions for conveyor position are disabled regardless of the play or teach mode, and the actual conveyor positions are displayed in \{CURRENT (mm)}\). When the MANUAL CONVEYOR display is called up after the power is turned ON, "****" appears in the column of \{SET (mm)}\). The set conveyor positions are retained until the power is turned OFF.

- **Definition of Conveyor Position**
  
  When the shift functions are used, the set conveyor position is defined as the distance from the manipulator start position as shown in the figure below. When the shift functions are not used, it is defined as the distance from the conveyor home-position limit switch.
  
  When the conveyor moves in the manual setting mode for conveyor position, the pulse value of the actual conveyor is read out, and the actual conveyor status on the conveyor shift table and the synchronization table are updated.

- **Additional Notes**
  
  - When the teach mode is switched to the play mode while the manual setting function for conveyor position is enabled, the manual setting function for conveyor position is automatically disabled.
  
  - The MANUAL CONVEYOR display can be viewed only in the teach mode.
  
  - The manual setting function for conveyor position is valid only when the turntable synchronization function is disabled.
3. Teaching
3.10 Test Run without Moving the Conveyor

### CAUTION

- During the test run using a virtual encoder, the manipulator moves in the pseudo conveyor synchronization. Therefore, the manipulator motion may be different from the taught motion. Make sure that no one is in the manipulator working envelope before starting the test run.

Injury may result from unintentional or unexpected manipulator motion.

A test run can be done to confirm the manipulator's motions without moving the conveyor in the teach mode. This is useful to confirm a continuous path and execution of each instruction.

For a job without the conveyor synchronization instruction, the test run can be carried out without any special settings. For a job with the conveyor synchronization instruction, however, the following operations are required to carry out this test run.

1. Set "ENCODER INPUT" of the conveyor condition file to "VIRTUAL ENCODER."

   Or, specify the virtual encoder by the general-purpose input signal. (Refer to section 2.2 "Editing Conveyor Condition File" for the setting method.)

2. Turn ON the conveyor home-position limit switch of the actual conveyor.

3. Select a job for which the test run is to be carried out and open its JOB CONTENT display.

   Press [INTERLOCK] and [TEST START] at the same time. The virtual encoder starts counting the pseudo pulses and the manipulator starts moving.
The test run starts by pressing [INTERLOCK] and [TEST START] at the same time. To assure the safe operation, the manipulator moves only while these keys are pressed.

For a job where a start shift distance (WORK SHIFT POS) is set, the distance can be temporally changed to “0.” In this way, only the manipulator’s motion can be confirmed by the test run without waiting the manipulator to move for the start shift distance.

Set “1” for the sensor parameter SE016 “Ignorance of shift distance in virtual conveyor mode” so that the start shift distance is changed to “0” in the virtual encoder mode.

![Diagram of conveyor system with start shift distance and home-position limit switches.](image-url)
3.11 Manual Setting Function for Pseudo ON of the Conveyor Home-position Limit Switch

When the conveyor home-position limit switch cannot be turned ON, it can be pseudonymously turned ON in the following manner.

1. Open the CV TRACKING STATUS display.

2. Move the cursor to the limit switch number connected to the conveyor home-position input signal that is set in PORT NO. in the conveyor condition file.

3. By pressing [INTERLOCK] and [SELECT] at the same time, select “ON” status to pseudonymously turn the conveyor home-position input signal ON.

The manual setting function for pseudo ON of the conveyor home-position limit switch is valid only in the TEACH mode. This function is disabled in the play mode.
4 Playback

4.1 Conveyor Speed Down

When the conveyor slows down while the manipulator moves in synchronization with the conveyor, the manipulator will react according to the mode setting in the conveyor condition file:

**Fig. 4-1: Conveyor Condition File Display**

<table>
<thead>
<tr>
<th>CV SPEED DOWN MODE</th>
<th>CV LOWER LIMIT SPD</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXECUTE</td>
<td>0.00</td>
</tr>
<tr>
<td>ALARM</td>
<td>0.00</td>
</tr>
<tr>
<td>PAUSE JOB</td>
<td>0.00</td>
</tr>
<tr>
<td>PAUSE JOB AFTER APRAY OFF</td>
<td>0.00</td>
</tr>
</tbody>
</table>

- **EXECUTE**
  Regardless of the conveyor speed, the manipulator continues moving. When the conveyor stops, the manipulator motion is synchronized with the conveyor speed “0.”

- **ALARM**
  When the conveyor average speed remains below the set value in “CONVEYOR LOWER LIMIT SPD” for 0.1 second, an alarm occurs and the manipulator stops.

- **PAUSE JOB**
  When the conveyor speed remains below the set value in “CONVEYOR LOWER LIMIT SPD” for 0.1 second, the job execution is interrupted (only the execution of move instructions in the job are suppressed) and the manipulator continues only follow-up motion in the conveyor moving direction. When the conveyor speed recovers to the set value in “CONVEYOR LOWER LIMIT SPD” or higher, the job execution restarts.

- **PAUSE JOB AFTER APRAY OFF**
  When the conveyor average speed remains below the set value in “CONVEYOR LOWER LIMIT SPD” for 0.1 second, the manipulator executes the job up to the spray off instruction, and then executes only the follow-up motion in the conveyor moving direction. When the conveyor speed recovers to the “CONVEYOR LOWER LIMIT SPD” or higher, the job execution restarts.

For the details of the above four modes, refer to section 2.1 “Conveyor Condition File” on page 2-1.

**NOTE**

The specific output 51420 turns ON when the conveyor slows down.
4.2 Accuracy

In the operation by the conveyor synchronized control, the manipulator motion path taught on the conveyor in stop status is reproduced on the conveyor in run status. Therefore, the accuracy of the operation is determined by the amount of difference between the taught motion path and the synchronized motion path. Since the object is moving, it is impossible to appreciate the accuracy in the same way as the repetitive positioning accuracy for still-object.

The amount of difference between the taught motion path and the synchronized motion path is resulted from the following factors. Even if the following factors are adjusted not to cause the difference, the amount of difference can be about ten times of the amount of difference resulted from the repetitive positioning for still-object.

- Linearity of the conveyor in the synchronization section
- Conveyor movements that are not indicated in the pulse data from the conveyor encoder (such as swings with hanger conveyor)
- Difference between the manipulator actual dimensions and the dimensions registered in the DX200
- Conversion resolution error that occurs when converting the pulse data from the conveyor encoder to the conveyor travel amount in mm
- Manipulator mechanical accuracy such as arm bending
- Follow-up delay due to the conveyor speed fluctuation
- Manipulator system lag time
- Difference between the conveyor moving direction and the travel-axis moving direction when the synchronization is performed by the travel-axis

4.3 Conveyor Resolution Error

The synchronization error resulted from the conveyor resolution setting error increases as the conveyor position value increases. The farther the conveyor moves, the bigger the synchronization error becomes. The minimum value for conveyor positional resolution setting is 0.01 μm. Therefore, a maximum error of 0.005 μm per pulse may occur.

Entering a correct resolution is especially required when using the conveyor synchronized function with shift functions because of its large follow-up distance.

For example, when the conveyor resolution is 10 μm per pulse and the synchronization distance is 2 m, 200,000 pulses are output when the conveyor moves for 2 m. Since the maximum error per pulse is 0.005 μm, the following synchronization error may occur: 200,000 pulses × 0.005 μm = 1 mm
4.4 Restarting Synchronization After Manipulator Stops

When a manipulator stops during the synchronized operation in the following cases, the manipulator restarts the synchronized motion when the operation is restarted.

- At occurrence of minor failure alarm (excluding occurrence of alarm related to the conveyor synchronized control)
- At emergency stop or external emergency stop
- By hold or external hold
- By switching the mode (mode switching between play and teach mode)
- By switching the operation cycle (switching among Auto/1 cycle/Step)

4.5 Continuance of Conveyor Synchronized Status

The conveyor synchronized status started by SYSTART instruction remains until SYEND instruction is executed or the control power supply is turned OFF. Even if a manipulator stops in the cases explained in the previous section, the conveyor synchronized status remains.

Note that a manipulator performs the synchronized motion by SYMOV instruction even if the cursor is moved in teach mode, the master job is called, or a job selection is made.

4.6 Continuance of Parallel Shift Status

The parallel shift status in the conveyor synchronized status continues even after a manipulator stops in the cases explained in the previous section. However, the parallel shift status is cleared in the following cases. Be careful when using the parallel shift function in combination with the conveyor synchronized control.

- Execution of SFTOF instruction
- The cursor is moved in teach mode.
- The master job is called.
- Job selection
- The main power supply is shut down.

4.7 Conveyor Synchronized Motion During Execution of TIMER and WAIT

While a manipulator is in waiting status by execution of TIMER, WAIT, etc. the manipulator continues the conveyor synchronized motion.
4.8 Detection of the Position beyond the Specified Maximum-workpiece-position

When a workpiece passes over the specified point (MAX. WORK POSITION) on the conveyor of the synchronized section without execution of the CVQUE instruction or the switching of workpieces, the position information, WORK ID information, and WORK IN/NOT information of the workpiece are automatically deleted from the job queue data.

Set the maximum workpiece position in the sensor parameter SxE13.
5 Conveyor Monitoring Displays for the Shift Functions

To monitor the conveyor synchronized status when using the shift functions, use the following display.

- CV (SYNCHRONIZATION) display

To monitor each shift status, use the following four displays.

- CV START SHIFT STATUS display
- CV WORK ID SHIFT STATUS display
- CV WORK IN/NOT SHIFT STATUS display
- CV SHIFT MONITOR display

■ Open the CV (SYNCHRONIZATION) Display

Open the CV (SYNCHRONIZATION) display in the following manner.

Select {ROBOT} under the main menu \(\rightarrow\) Select {CV (SYNCHRONIZATION)} \(\rightarrow\) The conveyor synchronization section monitor display appears \(\rightarrow\) Open the desired display

1 Pressing the [PAGE] switches the display.

Pressing [SHIFT] + [PAGE] returns to the previous display.

*Not displayed in new units shipped with version DN1.60-000 and later.

■ Open the CV (SHIFT) Display

Open the CV (SHIFT) Display in the following manner.

Select {ROBOT} under the main menu \(\rightarrow\) Select {CV (SHIFT)} \(\rightarrow\) The CV START SHIFT STATUS display appears \(\rightarrow\) Open a desired display

1 Press the area key, move the cursor to {DISPLAY} and press [SELECT]. Then, select the CV START SHIFT STATUS display, the CV WORK ID SHIFT STATUS display, or the CV WORK IN/NOT SHIFT STATUS display.

■ Open the CV SHIFT MONITOR Display

Open the CV SHIFT MONITOR Display in the following manner.

Select {ROBOT} under the main menu \(\rightarrow\) Select {CV SHIFT MONITOR} \(\rightarrow\) The CV SHIFT MONITOR display appears

*Displayed in new units shipped with version DN1.60-000 and later.
5 Conveyor Monitoring Displays for the Shift Functions

5.1 CV (SYNCHRONIZATION) MONITOR Display

*Not displayed in new units shipped with version DN1.60-000 and later.

1. CV#
   Displays the conveyor characteristic file number.

2. CONVEYOR AVERAGE SPEED (mm/s)
   Displays the conveyor average speed per 0.1 second.

3. FIND CNT
   Displays the number of workpieces that have passed the manipulator start position and are in the synchronizing section.

4. WORKPIECE No.
   Displays the workpiece number that is detected.

5. WORK POS (mm)
   Displays the distance between the position of the detected workpiece in synchronization and the manipulator start position in mm.
   When the painting operation for the first workpiece in synchronization is completed and the CVQUE instruction is executed, the workpiece for synchronization is switched to the next workpiece.

6. WORK ID INFORMATION
   Displays the WORK ID information of the detected workpiece in synchronization.
   When the CVQUE instruction is executed after the job for the first workpiece in the synchronized section has been completed, the reference workpiece for synchronization is changed to the next workpiece.

7. WORK IN/NOT INFORMATION
   Displays the WORK IN/NOT information of the detected workpiece in synchronization.
   When the CVQUE instruction is executed after the job for the first workpiece in the synchronization section has been completed, the reference workpiece for synchronization is changed to the next workpiece.
5 Conveyor Monitoring Displays for the Shift Functions

5.1 CV (SYNCHRONIZATION) MONITOR Display

5.1.1 Switching the Reference Workpiece for Synchronization

To switch the reference workpiece for synchronization from the currently objective workpiece to the next workpiece at teaching, follow the operation procedure below.

Press the area key → Select (DATA) → Select “SYNCHRONIZATION SWITCH”

1) Press the area key, move the cursor to [DISPLAY] and press [SELECT] to open the desired display.

The synchronization before switching the reference workpiece for synchronization is shown in the figure below. The workpiece for the current synchronization is the first workpiece on the conveyor synchronized section display.
Execute “SYNCHRONIZATION SWITCH” switches the objective workpiece to the next workpiece as shown in the figure below.

- The information of the workpiece for current synchronization is deleted by the execution of “SYNCHRONIZATION SWITCH” and UNDO operation is not possible. Observe the above precaution when “SYNCHRONIZATION SWITCH” is executed.
- “SYNCHRONIZATION SWITCH” is valid only when two or more workpieces are in the conveyor synchronized section. Do not execute “SYNCHRONIZATION SWITCH” operation when only one workpiece is in the conveyor synchronized section. Doing so causes an alarm because no workpiece exists to be switched.
5 Conveyor Monitoring Displays for the Shift Functions

5.1 CV (SYNCHRONIZATION) MONITOR Display

5.1.2 Deleting a Data of Conveyor Synchronized Section

Delete a data of conveyor synchronized section in the following manner.

Press the area key \(\rightarrow\) Select {DATA} \(\rightarrow\) Select "CLEAR DATA" \(^1\) \(\rightarrow\) Move the cursor to "YES" and press [ENTER]

\(^1\) The following display appears.

- While power is supplied to the DX200, the DX200 manages and updates automatically all the conveyor data regardless of the operation mode. Accordingly, deleting data while the conveyor is moving does not cause a problem. However, it may cause a malfunction due to inconsistency between the actual conveyor status and the DX200 conveyor data in the following cases:
  - The conveyor moves while power is not supplied to the DX200 or during the DX200 start sequence.
  - A momentary power failure occurs during operation in play mode.
  - The virtual conveyor mode is set with the setting “Ignorance of shift distance in virtual mode.”
- “CLEAR DATA” operation deletes the data on the currently active display. Delete a start shift data on the start shift data display, a WORK ID shift data on the WORK ID shift display, and a WORK IN/NOT shift data on the WORK IN/NOT shift display respectively. Delete unnecessary shift data according to the system configuration.
5.1.3 Deleting the Shift Data and the Data of Conveyor Synchronized Section

Delete the shift data and the data of conveyor synchronized section at a time in the following manner.

Press the area key → Select {DATA} → Select “ALL CLEAR”1) → Move the cursor to “YES” and press [ENTER]

1 The following display appears.

While power is supplied to the DX200, the DX200 manages and updates automatically all the conveyor data regardless of the operation mode. Accordingly, deleting data while the conveyor is moving does not cause a problem. However, it may cause a malfunction due to inconsistency between the actual conveyor status and the DX200 conveyor data in the following cases:

– The conveyor moves while power is not supplied to the DX200 or during the DX200 start sequence.
– A momentary power failure occurs during operation in play mode.
– The virtual conveyor mode is set with the setting “Ignorance of shift distance in virtual mode.”
5.2 CV START SHIFT STATUS Display

1. **CV#**
   Displays the conveyor start shift characteristic file number.

2. **CONVEYOR AVERAGE SPEED (mm/s)**
   Displays the conveyor average speed per 0.1 second.

3. **FIND CNT**
   Displays the number of workpieces that are detected by the start shift function and in the start shift section.

4. **WORKPIECE No.**
   Displays the detected start shift workpiece number.

5. **WORK POS (PULSE)**
   Displays the distance between the detected workpiece position and the manipulator start position in pulses.

6. **WORK POS (mm)**
   Displays the distance between the detected workpiece position and the manipulator start position in mm.

When the first workpiece in the shift section reaches the manipulator start position, the information of this workpiece is deleted and the information of the next workpiece is displayed on the top.
5.2 CV START SHIFT STATUS Display

5.2.1 Deleting a Conveyor Start Shift Data

*Cannot be used on new models shipped with version DN1.60-00 or later.

Delete a conveyor start shift data in the following manner.

Press the area key → Select (DATA) → Select “CLEAR DATA”1) → Move the cursor to “YES” and press [ENTER]

1) The following display appears.

- While power is supplied to the DX200, the DX200 manages and updates automatically all the conveyor data regardless of the operation mode. Accordingly, deleting data while the conveyor is moving does not cause a problem. However, it may cause a malfunction due to inconsistency between the actual conveyor status and the DX200 conveyor data in the following cases:
  - The conveyor moves while power is not supplied to the DX200 or during the DX200 start sequence.
  - A momentary power failure occurs during operation in play mode.
  - The virtual conveyor mode is set with the setting “Ignorance of shift distance in virtual mode.”

- “CLEAR DATA” operation deletes the shift data on the currently active display. Delete a start shift data on the start shift data display, a WORK ID shift data on the WORK ID shift display, and a WORK IN/NOT shift data on the WORK IN/NOT shift display respectively. Delete unnecessary shift data according to the system configuration.
5.2 CV START SHIFT STATUS Display

5.2.2 Deleting the Shift Data and the Data of Conveyor Synchronized Section

Delete the shift data and the data of conveyor synchronized section at a time in the following:

Press the area key → Select (DATA) → Select “ALL CLEAR” 1) → Move the cursor to “YES” and press [ENTER]

1) The following display appears.

- While power is supplied to the DX200, the DX200 manages and updates automatically all the conveyor data regardless of the operation mode. Accordingly, deleting data while the conveyor is moving does not cause a problem. However, it may cause a malfunction due to inconsistency between the actual conveyor status and the DX200 conveyor data in the following cases:
  - The conveyor moves while power is not supplied to the DX200 or during the DX200 start sequence.
  - A momentary power failure occurs during operation in play mode.
  - The virtual conveyor mode is set with the setting “Ignorance of shift distance in virtual mode.”
5.3 CV WORK ID SHIFT STATUS Display

### CV#
Displays the conveyor WORK ID shift characteristic file number.

### CONVEYOR AVERAGE SPEED (mm/s)
Displays the conveyor average speed per 0.1 second.

### FIND CNT
Displays the number of workpieces that are detected by the WORK ID shift function and in the WORK ID shift section.

### WORKPIECE No.
Displays the detected WORK ID shift workpiece number.

### WORK POS (PULSE)
Displays the distance between the detected workpiece position and the manipulator start position in pulses.

### WORK POS (mm)
Displays the distance between the detected workpiece position and the manipulator start position in mm.

When the first workpiece in the shift section reaches the manipulator start position, the WORK ID information of this workpiece is deleted and the WORK ID information of the next workpiece is displayed on the top.

### WORK ID
Displays the WORK ID number that is read by the WORK ID detecting limit switch.
5.3 CV WORK ID SHIFT STATUS Display

5.3.1 Deleting a Conveyor WORK ID Shift Data

*Cannot be used on new models shipped with version DN1.60-00 or later.

Delete a conveyor WORK ID shift data in the following manner.

Press the area key ➔ Select {DATA} ➔ Select "CLEAR DATA" ➔ Move the cursor to "YES" and press [ENTER]

1 The following display appears.

```
<table>
<thead>
<tr>
<th>Clear data?</th>
</tr>
</thead>
<tbody>
<tr>
<td>WORK ID. SHIFT</td>
</tr>
</tbody>
</table>

[YES] [NO]
```

- While power is supplied to the DX200, the DX200 manages and updates automatically all the conveyor data regardless of the operation mode. Accordingly, deleting data while the conveyor is moving does not cause a problem. However, it may cause a malfunction due to inconsistency between the actual conveyor status and the DX200 conveyor data in the following cases:
  - The conveyor moves while power is not supplied to the DX200 or during the DX200 start sequence.
  - A momentary power failure occurs during operation in play mode.
  - The virtual conveyor mode is set with the setting "Ignorance of shift distance in virtual mode."
- "CLEAR DATA" operation deletes the shift data on the currently active display. Delete a start shift data on the start shift data display, a WORK ID shift data on the WORK ID shift display, and a WORK IN/NOT shift data on the WORK IN/NOT shift display respectively. Delete unnecessary shift data according to the system configuration.
5.3.2 Deleting the Shift Data and the Data of Conveyor Synchronized Section

Delete the shift data and the data of conveyor synchronized section at a time in the following manner.

Press the area key → Select {DATA} → Select “ALL CLEAR”1) → Move the cursor to “YES” and press [ENTER]

1 The following display appears.

- While power is supplied to the DX200, the DX200 manages and updates automatically all the conveyor data regardless of the operation mode. Accordingly, deleting data while the conveyor is moving does not cause a problem. However, it may cause a malfunction due to inconsistency between the actual conveyor status and the DX200 conveyor data in the following cases:
  - The conveyor moves while power is not supplied to the DX200 or during the DX200 start sequence.
  - A momentary power failure occurs during operation in play mode.
  - The virtual conveyor mode is set with the setting “Ignorance of shift distance in virtual mode.”
5.4 CV WORK IN/NOT SHIFT STATUS Display

![Diagram of CV WORK IN/NOT SHIFT STATUS Display]

1. **CV#**
   - Displays the conveyor WORK IN/NOT shift characteristic file number.

2. **CONVEYOR AVERAGE SPEED (mm/s)**
   - Displays the conveyor average speed per 0.1 second.

3. **FIND CNT**
   - Displays the number of workpieces that are detected by the WORK IN/NOT shift function and in the WORK IN/NOT shift section.

4. **WORKPIECE No.**
   - Displays the detected WORK IN/NOT shift workpiece number.

5. **WORK POS (PULSE)**
   - Displays the distance between the detected workpiece position and the manipulator start position in pulses.

6. **WORK POS (mm)**
   - Displays the distance between the detected workpiece position and the manipulator start position in mm.

   When the first workpiece in the shift section reaches the manipulator start position, the WORK IN/NOT information of this workpiece is deleted and the WORK IN/NOT information of the next workpiece is displayed on the top.

7. **WORK IN/NOT INFORMATION**
   - Displays the WORK IN/NOT information that is read by the WORK IN/NOT detecting limit switch.
5.4 CV WORK IN/NOT SHIFT STATUS Display

5.4.1 Deleting a Conveyor WORK IN/NOT Shift Data

*Cannot be used on new models shipped with version DN1.60-00 or later.

Delete a conveyor WORK IN/NOT shift data in the following manner.

Press the area key → Select (DATA) → Select “CLEAR DATA”¹ → Move the cursor to “YES” and press [ENTER]

¹ The following display appears.

- While power is supplied to the DX200, the DX200 manages and updates automatically all the conveyor data regardless of the operation mode. Accordingly, deleting data while the conveyor is moving does not cause a problem. However, it may cause a malfunction due to inconsistency between the actual conveyor status and the DX200 conveyor data in the following cases:
  - The conveyor moves while power is not supplied to the DX200 or during the DX200 start sequence.
  - A momentary power failure occurs during operation in play mode.
  - The virtual conveyor mode is set with the setting “Ignorance of shift distance in virtual mode.”

- “CLEAR DATA” operation deletes the shift data on the currently active display. Delete a start shift data on the start shift data display, a WORK ID shift data on the WORK ID shift display, and a WORK IN/NOT shift data on the WORK IN/NOT shift display respectively. Delete unnecessary shift data according to the system configuration.
5.5 CV SHIFT MONITOR display

*Displayed in new units shipped with version DN1.60-000 and later.

- **CV#**
  Displays the conveyor characteristic file number.

- **CONVEYOR AVERAGE SPEED (mm/s)**
  Displays the conveyor average speed per 0.1 second.

- **FIND CNT**
  Displays the number of workpieces that have been detected using the shift function and are in the shift section.

- **WORKPIECE No.**
  Displays the workpiece number that is detected.

- **WORK POS (mm)**
  Displays the distance between the detected workpiece position and the manipulator start position in mm.
  When the workpiece in the shift section has not reached the manipulator start position, the negative value is displayed, and when the workpiece in the shift section reaches the manipulator start position, the positive value is displayed.

- **WORK ID INFORMATION**
  Displays the WORK ID information of the detected workpiece in synchronization.

- **WORK IN/NOT INFORMATION**
  Displays the WORK IN/NOT information of the detected workpiece in synchronization.
5.5.1 Switching the Reference Workpiece for Synchronization

To switch the reference workpiece for synchronization from the currently objective workpiece to the next workpiece at teaching, follow the operation procedure below.

Press the area key → Select {DATA} → Select "SYNCHRONIZATION SWITCH"

The synchronization before switching the reference workpiece for synchronization is shown in the figure below. The workpiece for the current synchronization is the first workpiece on the conveyor synchronized section display.

Execute "SYNCHRONIZATION SWITCH" switches the objective workpiece to the next workpiece as shown in the figure below.

The information of the workpiece for current synchronization is deleted by the execution of "SYNCHRONIZATION SWITCH" and UNDO operation is not possible. Observe the above precaution when "SYNCHRONIZATION SWITCH" is executed.
5-17

Conveyor Monitoring Displays for the Shift Functions

5.5 CV SHIFT MONITOR display

5.5.2 Deleting a Data of Conveyor Synchronized Section

Delete a data of conveyor synchronized section in the following manner.

Press the area key → Select [DATA] → Select "CLR TRACKING DATA"1) →
Move the cursor to "YES" and press [ENTER]

1 The following display appears.

While power is supplied to the DX200, the DX200 manages and updates automatically all the conveyor data regardless of the operation mode. Accordingly, deleting data while the conveyor is moving does not cause a problem. However, it may cause a malfunction due to inconsistency between the actual conveyor status and the DX200 conveyor data in the following cases:

- The conveyor moves while power is not supplied to the DX200 or during the DX200 start sequence.
- A momentary power failure occurs during operation in PLAY mode.
- The virtual conveyor mode is set with the setting "Ignorance of shift distance in virtual mode."
5.5.3 Deleting a Data of Conveyor Shift Section

Delete a data of conveyor shift section in the following manner.

Press the area key → Select {DATA} → Select "CLR SHIFT DATA" → Move the cursor to "YES" and press [ENTER]

1) The following display appears.

While power is supplied to the DX200, the DX200 manages and updates automatically all the conveyor data regardless of the operation mode. Accordingly, deleting data while the conveyor is moving does not cause a problem. However, it may cause a malfunction due to inconsistency between the actual conveyor status and the DX200 conveyor data in the following cases:

- The conveyor moves while power is not supplied to the DX200 or during the DX200 start sequence.
- A momentary power failure occurs during operation in play mode.
- The virtual conveyor mode is set with the setting "Ignorance of shift distance in virtual mode."

NOTE
5.5.4 Deleting the Shift Data and the Data of Conveyor Synchronized Section

Delete the shift data and the data of conveyor synchronized section at a time in the following manner.

Press the area key → Select {DATA} → Select “ALL CLEAR”→ Move the cursor to “YES” and press [ENTER]

1 The following display appears.

While power is supplied to the DX200, the DX200 manages and updates automatically all the conveyor data regardless of the operation mode. Accordingly, deleting data while the conveyor is moving does not cause a problem. However, it may cause a malfunction due to inconsistency between the actual conveyor status and the DX200 conveyor data in the following cases:

- The conveyor moves while power is not supplied to the DX200 or during the DX200 start sequence.
- A momentary power failure occurs during operation in play mode.
- The virtual conveyor mode is set with the setting “Ignorance of shift distance in virtual mode.”
### 6 Instruction List

The instructions used for the conveyor synchronized control with shift functions are listed below. The numerical data to be set is explained in <<>>.

<table>
<thead>
<tr>
<th>Instruction</th>
<th>Function</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SYSTART</strong></td>
<td>Starts the conveyor synchronized operation.</td>
<td>Additional items: CV## (&lt;Conveyor condition file&gt;) 1 to 3, STP= &lt;Synchronization start position in mm&gt;, OL= &lt;Tolerance in mm&gt; When omitted or 0 is set, the tolerance check is not executed.</td>
</tr>
<tr>
<td>Example</td>
<td>SYSTART CV#(1) STP=100.00</td>
<td></td>
</tr>
<tr>
<td><strong>SYMOVJ</strong></td>
<td>Moves the manipulator in joint interpolation in synchronization with the conveyor.</td>
<td>Additional items: CV## (&lt;Conveyor condition file&gt;) 1 to 3, CTP= &lt;Conveyor position at teaching in mm&gt;, VJ= &lt;Play speed in percentage&gt;</td>
</tr>
<tr>
<td>Example</td>
<td>SYMOVJ VJ=50.00 CV#(1) CTP=100.00</td>
<td></td>
</tr>
<tr>
<td><strong>SYMOVL</strong></td>
<td>Moves the manipulator in linear interpolation in synchronization with the conveyor.</td>
<td>Additional items: CV## (&lt;Conveyor condition file&gt;) 1 to 3, CTP= &lt;Conveyor position at teaching in mm&gt;, V= &lt;Play speed&gt;</td>
</tr>
<tr>
<td>Example</td>
<td>SYMOVL V=200.0 CV#(1) CTP=100.00</td>
<td></td>
</tr>
<tr>
<td><strong>SYMOVC</strong></td>
<td>Moves the manipulator in circular interpolation in synchronization with the conveyor.</td>
<td>Additional items: CV## (&lt;Conveyor condition file&gt;) 1 to 3, CTP= &lt;Conveyor position at teaching in mm&gt;, V= &lt;Play speed&gt;</td>
</tr>
<tr>
<td>Example</td>
<td>SYMOVC V=200.0 CV#(1) CTP=100.00</td>
<td></td>
</tr>
<tr>
<td><strong>SYEND</strong></td>
<td>Ends the conveyor synchronized operation.</td>
<td>Additional items: CV## (&lt;Conveyor condition file&gt;) 1 to 3, CONT CONT (continuity attribute) may be omitted.</td>
</tr>
<tr>
<td>Example</td>
<td>SYEND CV#(1)</td>
<td></td>
</tr>
<tr>
<td><strong>CVQUE</strong></td>
<td>Switches the workpiece for synchronization to the next workpiece.</td>
<td>Additional items: CV## (&lt;Conveyor condition file&gt;) 1 to 3</td>
</tr>
<tr>
<td>Example</td>
<td>CVQUE</td>
<td></td>
</tr>
<tr>
<td><strong>GETCVSFT</strong></td>
<td>Gets the synchronizable queue information.</td>
<td>Additional items: CV## (&lt;Conveyor condition file&gt;) 1 to 3, QUENO= &lt;Queue number&gt;1 to 99, WKIND &lt;WORK ID information storage location&gt;, WKEXIST &lt;WORK IN/NOT information storage location&gt;, RESULT &lt;Execution result storage location&gt;</td>
</tr>
<tr>
<td>Example</td>
<td>GETCVSFT CV#(1) QUENO=1 WKIND I000 WKEXIST I001 RESULT B000</td>
<td></td>
</tr>
</tbody>
</table>

1. SYMOVJ can be used only when the base axis is used for synchronization.
2. GETCVSFT can be used on new models shipped with version DN1.60-00 or later.
3. Queue number 1 indicates the oldest data existing in the queue. Queue number 2 indicates the second oldest data. For example, when GETCVSFT instruction is executed with specifying the queue number 2 while synchronizing, the next reference queue information for synchronization can be obtained.
## 7 Alarm List

<table>
<thead>
<tr>
<th>Alarm No.</th>
<th>Message</th>
<th>Causes</th>
<th>Corrective Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1003</td>
<td>ROM ERROR (YCP02)</td>
<td></td>
<td>Replace the YCP02 board (ROM).</td>
</tr>
<tr>
<td>1109</td>
<td>SYSTEM ERROR (CONVEYOR) [Decimal Data: 0 to 255]</td>
<td>Internal error.</td>
<td>Replace the YCP02 board.</td>
</tr>
<tr>
<td>1400</td>
<td>CONVEYOR ENCODER ERROR [Error occurred conveyor No.: 1, 2, 3]</td>
<td>Conveyor encoder error at the error occurred conveyor No.</td>
<td>Replace the encoder cable or the encoder.</td>
</tr>
<tr>
<td>1401</td>
<td>CANNOT CHANGE CONVEYOR MODE</td>
<td>The encoder selection “ENCODER/VIRTUAL ENCDR” has been switched by the general purpose input signal during the conveyor synchronized operation.</td>
<td>Switch the encoder by the general purpose input signal while the manipulator is not in the conveyor synchronized operation.</td>
</tr>
<tr>
<td>4021</td>
<td>MEMORY ERROR (CONVEYOR CONDITION FILE) [Decimal Data: 0 to 255]</td>
<td>The conveyor condition file data in the memory has been destroyed.</td>
<td>Initialize the conveyor condition file in customer maintenance mode.</td>
</tr>
<tr>
<td>4530</td>
<td>CONVEYOR SYNCHRONIZATION ERROR [Decimal Data: 0 to 255]</td>
<td>1: The base axis specification in the conveyor condition file is set to other than 0, 1, and 2. 2: The robot axis specified for tracking does not exist. 3: The base axis specified for tracking does not exist in the job. The error data other than 1, 2, and 3 is an internal error.</td>
<td>Turn the power OFF then back ON. If the alarm occurs again, contact your YASKAWA representative.</td>
</tr>
<tr>
<td>4531</td>
<td>UNDEFINED CONVEYOR CONDITION FILE [Decimal Data: 0 to 255]</td>
<td>The conveyor condition file specified for the job is not set to “USED.”</td>
<td>Set the conveyor condition file to “USED.”</td>
</tr>
<tr>
<td>4532</td>
<td>CONVEYOR SPEED DOWN [Decimal Data: 0 to 255]</td>
<td>When the mode for conveyor speed down mode in the conveyor condition file is set to “ALARM,” the conveyor speed is lowered to less than its lower limit specified in the conveyor condition file.</td>
<td>Increase the conveyor speed so that it becomes higher than the conveyor speed lower limit specified in the conveyor condition file.</td>
</tr>
<tr>
<td>4533</td>
<td>ARITHMETIC ERROR [Decimal Data, 0 to 255]</td>
<td>Internal error.</td>
<td>Turn the power OFF then back ON. If the alarm occurs again, contact your YASKAWA representative.</td>
</tr>
<tr>
<td>4538</td>
<td>CAN NOT USE SMOVJ DURING TRACKING [10], Decimal Data, 0 to 255</td>
<td>SYMOVJ was executed when a robot axis was used for synchronization.</td>
<td>SYMOVJ can be used only when the base axis is used for synchronization.</td>
</tr>
</tbody>
</table>
## Alarm List

<table>
<thead>
<tr>
<th>Alarm No.</th>
<th>Message</th>
<th>Causes</th>
<th>Corrective Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>4637</td>
<td>NO MORE WORKPIECE IN SYN SECTION</td>
<td>The CVQUE instruction is executed, but there is no more workpiece in the synchronization section.</td>
<td>Check the workpieces in the synchronization section and the data for the synchronization section.</td>
</tr>
<tr>
<td>4638</td>
<td>NO MORE WORKPIECE ID DATA IN SYN SECTION</td>
<td>The CVQUE instruction is executed, but there is no more workpiece in the synchronization section.</td>
<td>Check the workpieces in the synchronization section and the data for the synchronization section.</td>
</tr>
<tr>
<td>4727</td>
<td>GETCVSFT ERROR</td>
<td>An error occurred at GETCVSFT command execution.</td>
<td>Check the conveyor condition file and the conveyor supplemental condition file.</td>
</tr>
<tr>
<td>4728</td>
<td>CONVEYOR SYNCHRONIZATION (SHIFT FUNCTION) ERROR</td>
<td>An error occurred at conveyor synchronization (shift function) execution.</td>
<td>Check the conveyor supplemental condition file.</td>
</tr>
<tr>
<td>5020</td>
<td>SENSOR PARAMETER ERROR</td>
<td>On the YCP02 board, when parameters were calculated using data in the conveyor condition file, an operation error occurred.</td>
<td>Check whether the data are properly set in the conveyor condition file. Confirm that “0” is not set for the user coordinate number.</td>
</tr>
<tr>
<td>5022</td>
<td>CONVEYOR POSITION LIMIT OVER</td>
<td>The corrected conveyor position value exceeds ±21 m.</td>
<td>Review the synchronization section. After this alarm occurs, the conveyor position is not updated. Therefore, the synchronized operation is not performed after the alarm is reset, and the manipulator continues operation at the position where the alarm occurred.</td>
</tr>
<tr>
<td>5023</td>
<td>CONVEYOR COUNTER LIMIT OVER</td>
<td>The conveyor position counter pulse overflow</td>
<td>Review the conveyor resolution or the synchronization section. After this alarm occurs, the conveyor position is not updated. Therefore, the synchronized operation is not performed after the alarm is reset, and the manipulator continues operation at the position where the alarm occurred.</td>
</tr>
<tr>
<td>5024</td>
<td>CONVEYOR SUPPLEMENTAL CONDITION FILE ERROR</td>
<td>A conveyor supplemental condition file setting error occurred.</td>
<td>Check the conveyor supplemental condition file.</td>
</tr>
<tr>
<td>5070</td>
<td>WORK IN/NOT SHIFT DATA OVERFLOW</td>
<td>The WORK IN/NOT shift data overflow</td>
<td>Check the shift data and the actual workpiece status. If any inconsistency is found, delete the shift data and prepare newly the shift data.</td>
</tr>
<tr>
<td>5071</td>
<td>WORK ID SHIFT DATA OVERFLOW</td>
<td>WORK ID shift data overflow</td>
<td>Check the shift data and the actual workpiece status. If any inconsistency is found, delete the shift data and prepare newly the shift data.</td>
</tr>
<tr>
<td>Alarm No.</td>
<td>Message</td>
<td>Causes</td>
<td>Corrective Actions</td>
</tr>
<tr>
<td>----------</td>
<td>----------------------------------------------</td>
<td>---------------------------------------------</td>
<td>-------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>5072</td>
<td>START SHIFT DATA OVERFLOW</td>
<td>Start shift data overflow</td>
<td>Check the shift data and the actual workpiece status. If any inconsistency is found, delete the shift data and prepare newly the shift data.</td>
</tr>
<tr>
<td>5073</td>
<td>SHIFT DATA OVERFLOW IN SYNCHRONIZATION SECTION</td>
<td>Shift section data overflow</td>
<td>Check the tracking area data in the synchronized section and the actual workpiece status. If any inconsistency is found, delete the shift data in the synchronized section and prepare newly the shift data.</td>
</tr>
<tr>
<td>5075</td>
<td>FAIL TO SUSPEND CONVEYOR ENCODER</td>
<td>The encoder was not in suspend status when the control power supply was turned ON.</td>
<td>Check the shift data and the actual workpiece status. If any inconsistency is found, delete the shift data and prepare newly the shift data.</td>
</tr>
<tr>
<td>5076</td>
<td>TRACKING AREA IN/NOT DATA POSITION LIMIT</td>
<td>The WORK IN/NOT data of the first workpiece in the synchronized section exceeds the preset value.</td>
<td>Delete the WORK IN/NOT data in the synchronized section.</td>
</tr>
<tr>
<td>5077</td>
<td>TRACKING AREA ID. DATA POSITION LIMIT</td>
<td>The WORK ID data of the first workpiece in the synchronized section exceeds the preset value.</td>
<td>Delete the WORK ID data in the synchronized section.</td>
</tr>
<tr>
<td>1402</td>
<td>WORK IN/NOT SHIFT DATA COUNT LIMIT OVER</td>
<td>The current position pulse operation error in the WORK IN/NOT shift data</td>
<td>Check the WORK IN/NOT shift data and the actual workpiece status.</td>
</tr>
<tr>
<td>1403</td>
<td>WORK IN/NOT SHIFT DATA POSITION LIMIT OVER</td>
<td>The current travel distance operation error in the WORK IN/NOT shift data</td>
<td>Check the WORK IN/NOT shift data and the actual workpiece status.</td>
</tr>
<tr>
<td>1404</td>
<td>WORK ID SHIFT DATA COUNT LIMIT OVER</td>
<td>The current position pulse operation error in the WORK ID shift data</td>
<td>Check the WORK ID shift data and the actual workpiece status.</td>
</tr>
<tr>
<td>1405</td>
<td>WORK ID SHIFT DATA POSITION LIMIT OVER</td>
<td>The current travel distance operation error in the WORK ID shift data</td>
<td>Check the WORK ID shift data and the actual workpiece status.</td>
</tr>
<tr>
<td>1406</td>
<td>START SHIFT DATA COUNT LIMIT OVER</td>
<td>The current position pulse operation error in the start shift data</td>
<td>Check the start shift data and the actual workpiece status.</td>
</tr>
<tr>
<td>1407</td>
<td>START SHIFT DATA POS LIMIT OVER</td>
<td>The current travel distance operation error in the start shift data</td>
<td>Check the start shift data and the actual workpiece status.</td>
</tr>
</tbody>
</table>
8 Specific I/O Signals

8.1 Specific Input Signals “4xxxx"

- 40700 to 40702: Conveyor Home-position Limit Switch Input
  
  When this signal turns ON, the conveyor home-position limit switch turns ON. Each specific input signal corresponds to the following conveyor home-position limit switches.
  
  Conveyor home-position limit switch 1 input: 40700
  Conveyor home-position limit switch 2 input: 40701
  Conveyor home-position limit switch 3 input: 40702

- 41020: Delete All Shift Data
  
  All the shift data are deleted by turning ON this signal.

- 41021: Delete All Synchronization Data
  
  All the synchronization data are deleted by turning ON this signal.

- 41022: Single Work Control (Tracking Area)
  
  While this signal is ON, the DX200 manages only the latest information of the workpiece in the conveyor synchronized section. When another workpiece passes the manipulator start position, the XRC overwrites the currently-stored workpiece information with the newly-entered workpiece information.

8.2 Specific Output Signals “5xxxx”

- 51100 to 51102: Conveyor Home-position Limit Switch Output
  
  Indicates the status of the conveyor home-position limit switch. Each specific output signal corresponds to the following conveyor home-position limit switches.
  
  Conveyor home-position limit switch 1 output: 51100
  Conveyor home-position limit switch 2 output: 51101
  Conveyor home-position limit switch 3 output: 51102
8.2 Specific Output Signals “5xxxx”

- **51410: SYMOVJ in Execution**
  
  Indicates that the move instruction “SYMOVJ” for the conveyor synchronized motion is being executed.

- **51420: Conveyor Speed Down**
  
  Indicates that the conveyor speed falls below the lower limit of the speed that is set in the Conveyor Condition File.

- **51430 to 51432: Disconnection Detected**
  
  Indicates the detected disconnection of the conveyor pulse signals. Each specific output signal corresponds to the following Conveyor Condition Files.
  
  - Conveyor Condition File No. 1: 51430
  - Conveyor Condition File No. 2: 51431
  - Conveyor Condition File No. 3: 51432
9 Conveyor Parameters

- **S3C1210: Conveyor Model Speed for SYMOVJ**
  Specifies the conveyor speed at the execution of the SYMOVJ instruction when “ROBOT AXIS” is selected for “TRACKING” in the Conveyor Condition File. If “0” is set, the DX200 refers to the actual conveyor speed immediately before the execution of SYMOVJ.
  Set the conveyor speed to the conveyor model speed for SYMOVJ for the system where the conveyor speed varies largely.
  - Units: μm/s

- **S3C1211: Lower Limit of the Conveyor Speed for SYMOVJ**
  Sets the lower limit of the conveyor speed at the execution of the SYMOVJ instruction when “ROBOT AXIS” is selected for “TRACKING” in the Conveyor Condition File.
  The specific output 51420 turns ON when the conveyor speed falls below the set speed.
  - Units: μm/s

- **S2C769: Switch the conveyor speed unit of conveyor monitor**
  This parameter switch the conveyor speed unit of the conveyor monitor.
  0: The conveyor speed is displayed by (mm/sec).
  1: The conveyor speed is displayed by (m/min).

- **S2C770: The conveyor speed update timing of conveyor monitor**
  This parameter change the conveyor speed update timing of the conveyor monitor.
  0 : Display conveyor speed is updated at real time.
  Excluding 0: The conveyor speed update timing is value * 100msec.
10 Sensor Parameters (SxE)

Use the sensor parameters with their initial value settings.

<table>
<thead>
<tr>
<th>No.</th>
<th>Contents</th>
<th>Initial Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Application designation</td>
<td>16</td>
</tr>
<tr>
<td>1</td>
<td>Time to recognize the input of start signal</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>Reference time to recognize the occurrence of speed down</td>
<td>100</td>
</tr>
<tr>
<td>3</td>
<td>Time for averaging the speed variation amount</td>
<td>60</td>
</tr>
<tr>
<td>4</td>
<td>Time to recognize the falling edge of start signal</td>
<td>5</td>
</tr>
<tr>
<td>13</td>
<td>Maximum workpiece position (0 to 2000m) [2]</td>
<td>0</td>
</tr>
<tr>
<td>14</td>
<td>Data overflow alarm specification</td>
<td>0</td>
</tr>
<tr>
<td>15</td>
<td>Manual setting function for conveyor home-position limit switch</td>
<td>0</td>
</tr>
<tr>
<td>16</td>
<td>Ignorance of shift distance in virtual conveyor mode</td>
<td>0</td>
</tr>
<tr>
<td>17</td>
<td>Output time of detection signal for disconnection</td>
<td>0</td>
</tr>
</tbody>
</table>

1 The time to recognize the input of start signal (S1E) indicates the time from the moment that the conveyor home-position limit switch turns ON until the DX200 confirms the conveyor home-position limit switch ON input signal. The setting range is from 1 to 1000. Use the parameter S1E with its initial setting. However, if the conveyor home-position limit switch malfunction occurs frequently, change the setting to a bigger value as required.

2 The maximum workpiece position indicates the distance between the workpiece position and the manipulator start position. When a workpiece is carried for this distance from the manipulator start position, the DX200 automatically deletes the workpiece information from the job queue or issues the alarm. Whether to automatically delete the information or issue the alarm can be selected by the setting of the sensor parameter No.14 “Data overflow alarm specification.” While the conveyor synchronization is not executed, however, the workpiece information is automatically deleted from the job queue regardless of the setting of the sensor parameter No.14.
DX200 OPTIONS
INSTRUCTIONS
FOR CONVEYOR SYNCHRONIZED FUNCTION WITH SHIFT FUNCTIONS

HEAD OFFICE
2-1 Kurosakishiroishi, Yahatanishi-ku, Kitakyushu 806-0004, Japan
Phone  +81-93-645-7703  Fax  +81-93-645-7802

YASKAWA America Inc. (Motoman Robotics Division)
100 Automation Way, Miamisburg, OH 45342, U.S.A.
Phone  +1-937-847-6200  Fax  +1-937-847-6277

YASKAWA Europe GmbH (Robotics Division)
Yaskawastrasse 1, 85391 Allershausen, Germany
Phone  +49-8166-90-100  Fax  +49-8166-90-103

YASKAWA Nordic AB
Verkstadsgatan 2, Box 504, SE-385 25 Torsas, Sweden
Phone  +46-480-417-800  Fax  +46-486-414-10

YASKAWA Electric (China) Co., Ltd.
22F, One Corporate Avenue, No.222, Hubin Road, Huangpu District, Shanghai 200021, China
Phone  +86-21-5385-2200  Fax  +86-21-5385-3299

YASKAWA SHOUGANG ROBOT Co. Ltd.
No7 Yongchang North Road, Beijing E&T Development Area, China 100176
Phone  +86-10-6789-2858  Fax  +86-10-6789-2878

YASKAWA India Private Ltd. (Robotics Division)
#426, Udyog Vihar, Phase- IV, Gurgaon, Haryana, India
Phone  +91-124-475-8500  Fax  +91-124-475-8542

YASKAWA Electric Korea Corporation
35F, Three IFC, 10 Gukjegeumyung-ro, Yeongdeungpo-gu, Seoul, Korea 07326
Phone  +82-2-784-7844  Fax  +82-2-784-8495

YASKAWA Electric Taiwan Corporation
12F, No.207, Sec. 3, Beishin Rd., Shindian District, New Taipei City 23143, Taiwan
Phone  +886-2-8913-1333  Fax  +886-2-8913-1513

YASKAWA Electric (Singapore) PTE Ltd.
151 Lorong Chuan, #04-02A, New Tech Park, Singapore 556741
Phone  +65-6282-3003  Fax  +65-6289-3003

YASKAWA Electric (Thailand) Co., Ltd.
59,1st-5th Floor, Flourish Building, Soi Ratchadapisek 18,Ratchadapisek Road, Huaykwang, Bangkok 10310, THAILAND
Phone  +66-2-017-0099  Fax  +66-2-017-0199

PT. YASKAWA Electric Indonesia
Secure Building-Gedung B Lantai Dasar & Lantai 1 Jl. Raya Protokol Halim Perdanakusuma, Jakarta 13610, Indonesia
Phone  +62-21-2982-6470  Fax  +62-21-2982-6741

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